MAY 27 1924
PERIODICAL ROOM
GENERAL LIBRARY

The ELECTRICAL REVIEW

FOUNDED 1872

VOL. XCIV. No. 2425. [All Rights Reserved.] MAY 16, 1924. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage.] PRICE SIXPENCE.

LITHOLITE INSULATORS, Ltd.
55–57, Hackney Grove, London, E. 8.
'Phone and Telegrams: Dalston, 592, London.
FIREPROOF AND OTHER GRADES.
ESTABLISHED OVER 20 YEARS

The Acme Production Co., Ltd., *Electrical Specialities Manufacturers.* **Automatic Flashers** Britannia Works, Rolfe St. and Engine St., SMETHWICK, BIRMINGHAM.

WRIGHT Tel.: Motor.
A.C. and D.C. **MOTORS.**
WRIGHT MOTORS, Ltd., HALIFAX.

RESISTANCE MATERIALS
Asbestos Woven Resistance Grids. Resistance Cord. Resistance Wires & Tapes.
CRESSALL MANUFACTURING CO.,
Staniforth Street, BIRMINGHAM.
Telegrams: "Ohmic, Birmingham." Telephone: Central 3468.

LANTERN REFLECTOR WATERTIGHT AND SHIPS' FITTINGS.
E.L.E.C., LTD.
with Anti-Vibrator Discs.
ENGINEERING & LIGHTING EQUIPMENT CO., LTD.,
Sphere Works, St. Albans, Herts.

SURGE ARRESTERS AND—
See next announcement.
ISENTHAL & CO., LTD.,
Denzil Works, Willesden, N.W. 10.

SWITCHGEAR.
ERNEST F. MOY, LTD.,
Manufacturing Electrical Engineers and Government Contractors.
GREENLAND PLACE, CAMDEN TOWN, LONDON.

MICA PLATES for WIRELESS CONDENSERS and MAGNETOS. RINGS for HIGH TENSION, X-RAY and ELECTRICAL INSTRUMENTS. DIAPHRAGMS for SOUND BOXES and LOUD SPEAKERS. COMMUTATOR Segments, V-RINGS, Washers, Tubes, &c.
MICA AND MICANITE INSULATION
TAYLOR & PETTERS, Ld., 40, Hatton Garden,
'Phone: Holborn 2981. E.C. 1.

JULIUS SAX
Specialists in
E... **BELLS** 1855.
and
Wall Plugs.
24a, High Street, Bloomsbury, W.C.2.

CHURTON
SINGLE and POLYPHASE
MOTORS.
T. HARDING CHURTON & CO., LTD.,
Atlas Works, Water Lane, LEEDS

ELECTRIC MOTOR REPAIRS.
ARMATURES REWOUND.
H. DUNN & SON,
Newington Causeway,
Tel.: Hop. 1167. LONDON, S.E. 1.

"EMPIRE"
HIGH TENSION LINE EQUIPMENT,
Up to 132,000 Volts.
Ave. 14 **British Empire EXHIBITION.** Bay 8
ELECTRIC CONTROL, Ltd., GLASGOW.

THE PRACTICE OF ELECTRICAL WIRING
By DONALD SMEATON MUNRO,
M.I.E.E., M.ASSOC. MINING E.E.
5/- net, or by post 5/4.
THE ELECTRICAL REVIEW, LTD., 4, Ludgate Hill, E.C.4.

WESTERN-ELECTRIC
COMPANY, LIMITED,
Connaught House, Aldwych, W.C. 2.
Works: NORTH WOOLWICH, LONDON, E.
TELEPHONES & CABLES.
See Advertisement this week, p. xx.

Cutting
Electric Motors.
CUTTING BROS., LTD., STAMFORD.
Telegrams: Cutting, Stamford. Tel. No. 12.

WHITE
Electrical Instrument Co., Ltd.
2, 4 & 6, GLOUCESTER ST., CLERKENWELL, LONDON, E.C. 1.
Wire, Voltograph, London. 'Phone: Clerkenwell 6399.

Electrical
INSULATING MATERIALS and WIRELESS COMPONENTS EBONITE
SPICERS, LIMITED (Insulation Dept.),
19, New Bridge Street, London, E.C. 4.
'Grams: Nyhoping, Lud, London. 'Phones: City 6251, Ex. 49.
See our Advt. on page xxiv. of this issue.

INSULATING
- - BEADS - -
Immediate Delivery.
HOLDER-HARRIDEN LTD., 1-2, Chiswell St., London, E.C.

The Wonders of Wembley.
See Sup. 8.

DERMATINE
JOINTING
PUMP VALVES
HOSE & TUBING
BELTING
Dermatine Co., Ltd., Neate St., London, S.E. 5.

SHUNT REGULATORS.
MOTOR STARTERS and all classes of Resistance Work.
STAR DELTA SWITCHES.
THE SOLENOID REGULATOR CO.,
HIGHGATE SQUARE, CAMP HILL,
Telephone: Midland 532 BIRMINGHAM. Telegrams: Solenoid, Birmingham.

ALUMINIUM for BATTERY CONNECTIONS.
The British Aluminium Co., Ltd., 109, Queen Victoria St., London.

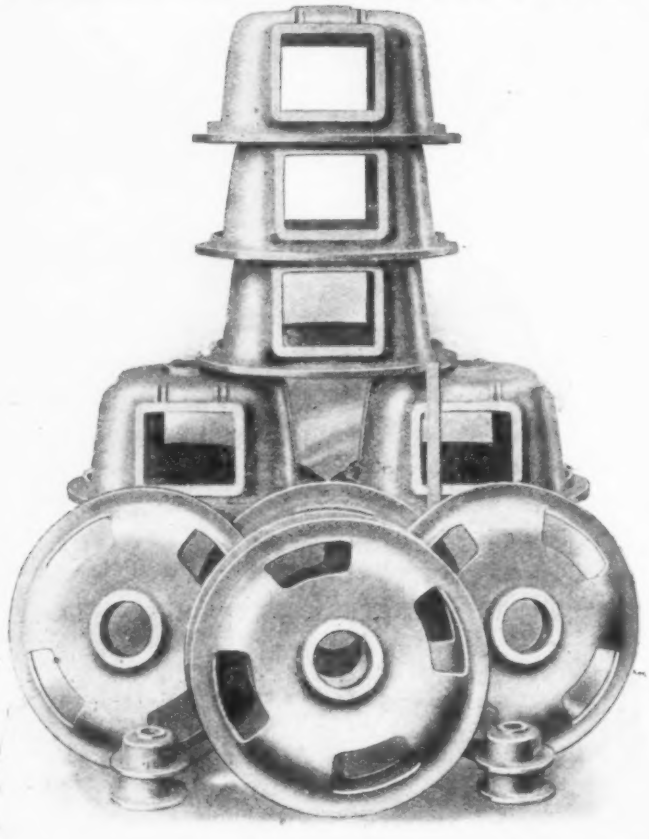
MAVOR & COULSON, Ltd.,
GLASGOW.
MOTORS, DYNAMOS, SWITCHGEAR.
CONVEYORS & ELEVATORS.
Power Station, Coal & Ash Handling Plants.
FRASER & CHALMERS ENGINEERING WORKS,
(*Proprietors*: The General Electric Co., Ltd.)
ERITH, KENT. *London Office:* Magnet House, Kingsway, W.C. 2.
Associated with Robins Conveying Belt Co., of U.S.A.

CARSON'S
27, UPPER THAMES ST., E.C. 4.
'Grams: "Irishis 2 Cent. London." 'Phone: Central 6967.
INSULATORS.

FULLER'S UNITED ELECTRIC WORKS, LIMITED.
MANUFACTURERS OF
ACCUMULATORS BATTERIES
WIRES & CABLES EBONITE
WIRELESS APPARATUS CARBON BLACK
Head Office: (General Sales Offices and Works).
WOODLAND WORKS, GROVE ROAD,
CHADWELL HEATH, ESSEX.

INGLEBY & Co., Ltd.
BEESTON.
LEEDS
ELECTRIC MOTORS.

Advertisement Index, see page xliv. *Official Notices, see Sup. 36.*



MOTOR END BRACKETS IN WILMIL ALLOY FOR H.M. ADMIRALTY.

Malleable
ALUMINIUM CASTINGS.

A featherweight substitute for brass or iron—cheaper than the former in first cost—more economical than the latter wherever parts must be accelerated.

NON-MAGNETIC.

NON-CORROSIVE.

LIGHTER *than* ALUMINIUM.

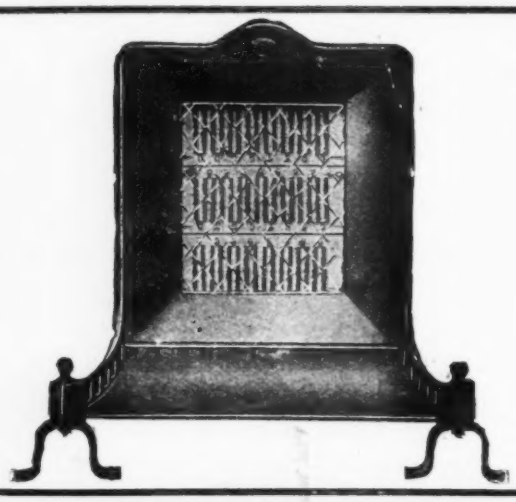
STRONGER *than* CAST-IRON.

WILLIAM MILLS, LTD.,
Grove Street,
BIRMINGHAM.

MICA & MICANITE

INSULATORS FOR EVERY DESCRIPTION OF ELECTRICAL WORK.
We supply to The Trade Three-quarters of a Million Mica Condenser Plates weekly.
SUPERFINE "MICAYLOR" DIAPHRAGMS FOR SOUND BOXES.
CUTTING, GAUGING AND MACHINING OUR SPECIALITY.

'PHONE—2381 HOLBORN.
TELEGRAMS—"MICAYLOR, LONDON."
TAYLOR & PETTERS, LTD.,
40, HATTON GARDEN,
LONDON, E.C. 1.
(The Oldest Established Mica House in the country.)
AND ALL BRITISH.



THE
ARORA ELECTRIC FIRE

Has given universal satisfaction.

WHY? Because OUR patented Element is of HEAVY SECTION and has LOW Current Density, yet it glows at a HIGH TEMPERATURE.

Low Price, Robust, Cheery, Economical.

Write for List E (Fires & Cookers) to Sole Manufacturers:
THE ARORA CO., Loughborough
(Proprietors: MESSENGER & Co., LTD.)

SEND IT TO—

REPAIRS WINDS DESIGNS

COLLINS ELEC. LTD.,

115, CLERKENWELL ROAD, LONDON, E.C. 1. TEL: HOLBORN 212.

The

Electrical Review

VOL. XCIV. MAY 16, 1924. No. 2,425.

THE OLDEST ELECTRICAL PAPER. ESTABLISHED 1872.

Published every FRIDAY, Price 6d.

Chairman: H. ALABASTER.

Technical Editor: A. H. ALLEN, M.I.E.E. *Joint Managing Directors:* G. H. ALABASTER. E. A. GATEHOUSE, M.I.E.E. A.M.INST.C.E. *Commercial Editor:* A. H. BRIDGE.

Manager and Secretary: E. S. MIDDLETON.

OFFICE: 4, LUDGATE HILL, LONDON, E.C.4.

Telegraphic Address: "AGEKAY, CENT., LONDON," Code, A B C. Telephone Nos.: Central 8260 and 8261

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum. Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "Midland Bank, Newgate Street Branch."

LIST OF FOREIGN AGENTS (see first page "Official Notices").

Contents:

	PAGE
The Popular Touch Needed at the Exhibition...	777
How to Keep "Fit" at Wembley ...	778
Power Transmission Lines ...	778
The World Power Conference ...	779
Division of Profits and the Question of Costs...	779
The I.E.E. Report ...	779
Power Transmission Lines—I, by William T. Taylor (*Illus.*) ...	780
Why Not Allow Rebates Instead of Charging Extras? by E. G. Ross ...	782
The Institution of Electrical Engineers ...	784
Lanarkshire Hydro-electric Power Bill ...	785
The London and Home Counties Electricity District (*continued*) ...	786
The World Power Conference ...	789
Legal ...	789
Correspondence—	
The "Transverter" ...	790
The A.C. Commutator Motor and the Engineer's Education ...	791
The Single-phase Induction Motor and the Starting Problem ...	791
Pulverised Coal ...	791
Business Notes ...	792
Lighting and Power Notes ...	794
Tramway and Railway Notes ...	796
Telegraph and Telephone Notes ...	796
Linking London's Underground Railways (*Illus.*) ...	797
Electrical Installations at the Port of Genoa (*Illus.*)...	800
Radio Notes ...	801
Contracts Open and Closed ...	801
Forthcoming Events ...	802
Notes ...	803
Institution Notes ...	804
Our Personal Column...	804
New Companies Registered ...	805
Official Returns of Electrical Companies ...	805
City Notes ...	805
Stocks and Shares ...	807
Market Quotations for Chemicals and Metals ...	808
Boiler-room Practice, by John Bruce (*Illus.*) (*concluded*)	809
Swiss Trade Statistics ...	811
Some of the Exhibits at Wembley (*Illus.*) ...	813
The Engineer's Club (London) ...	816
A Tapping Switch for Power Transformers (*Illus.*) ...	817
The Junior Institution of Engineers ...	817
New Electrical Devices, Fittings, and Plant (*Illus.*) ...	818
Electrocultural Research ...	819
Parliamentary ...	819
Published Specifications ...	820
Contractors' Column ...	Advertisement page xxx

The Popular Touch Needed at the Exhibition.

IT should hardly be necessary to state again that the real purpose of the British Empire Exhibition is not to form one huge trade-counter for the immediate sale of British goods. Sales are, of course, being effected, and we hope that many and substantial orders will be booked by exhibitors who have taken space in the Palace of Engineering. But lasting industrial prestige as the result of an effective demonstration before the whole world, and especially before the constituent parts of the British Empire, is more to be desired than immediate transactions of the over-counter sales type, eagerly as these are being sought, and it is the long-sighted view that has led our manufacturers to invest money so freely. We believe that the favourable effects of the Exhibition upon trade and industry will, given suitable atmospheric conditions, begin to show themselves before October comes, but we all want permanent improvement and, as far as it ever can be made permanent, reduction of unemployment.

We have alluded above to the money spent by engineering exhibitors as *an investment*. It *is* an investment upon which we all desire to secure a permanent return, but we have not put our money down, as many men do when they take up shares in a concern, to leave it to take its chance of yielding a dividend as circumstances permit. We have some power in shaping the circumstances which will produce the return in this case, and we ought to spare no effort to secure a maximum ultimate return which shall be continuous.

There are parts of the electrical display which are intended to impress the layman and make him at an early date a consumer, or a larger consumer, of electricity, and the young and rising generation will come under the fascinations of such an influence to both immediate and ultimate benefit of the electrical industry. The electrical and engineering exhibits should impress the general public as investors in manufacturing companies by raising the prestige of the industry by the excellence of their demonstration. The whole Em-

pire should secure a new and larger view of our engineering skill and resources from what it sees at Wembley, and engineering as a profession, an industry, and a trade will stand higher in the general estimation.

We ought each to look at our own little Wembley and see whether it is doing all that is possible to make the right impression upon the lay mind, because while the show is, in the main, a technical one, it cannot completely fulfil its purpose unless it impresses non-technical, as well as technical, visitors. Now if the technical man, in going round the Palace of Engineering, feels the need of something more in the way of the showman's art in order that he may quickly grasp things, it is certain that the layman will often experience little more than mystification. Yet it must be recognised that, essential as it is to give the technical student and buyer every possible assistance in his search for knowledge, it is also true that anything that we do towards interesting and instructing the layman in technical matters will react to the advantage of the industry.

We have no doubt that as a result of two or three weeks' experience it will be found possible to introduce some popularising means which will draw the public in their thousands to the E.D.A. exhibit and will keep them there interested, perhaps entranced. We need not be afraid of loss of dignity in this corner of the Palace of Engineering. Light, colour, magic, even occasional noise and other things which form part of the showman's stock-in-trade, may be enlisted to give more life without any fear, in order to make a popular appeal such as the times seem to call for, and when we have brought the people around we must be as free and confident in our approach to them as is the man at the country fair.

The main purpose of providing a well-assorted and well-arranged selection of exhibits has already been accomplished, both as regards the technical visitor and the layman. As we have already said, everyone will find not merely something to interest him, but much. Up to a point the electrical exhibits at Wembley are all that they should be. The missing link is thought to be the showman's touch, and it is timely to suggest the wisdom of enlisting it while the days are young.

It may be said with safety that the great majority of visitors will go to see the Exhibition as a whole. By the art of the showman we must induce them to enter the Palace of Engineering, even though they had no particular intention of going there, and we must retain their interest once they are inside. Incidentally, we may point out that the exhibits are not, as some suppose, incomplete; they are finished and ready for inspection, and there is not the slightest reason to delay one's visit on that score.

As a general axiom, the more visitors in the Palace of Engineering the better. That being so, why not blazon forth some of the attractions in popular terms, if not around the Palace, then at least at every entrance? Visitors, whether serious or casual, would greatly appreciate a simple block plan at each entrance showing the general lay-out of the exhibits; also a good proportion would buy catalogues if they were conspicuously available. Official inquiry bureaus and official publications offices are all very well as part of a well-oiled organisation but, for the great majority of the visitors, who are there for the first time that day, announcements must be before their eyes, and catalogues everywhere to hand. It ought not to be necessary to go in search of them.

What is true of the Palace of Engineering as a whole applies also to individual exhibits. In more than one instance it is found to be impossible to decide the exact purpose for which a particular exhibit is intended, and in other cases one cannot decipher the rating plates of giant apparatus towering far overhead. Whilst such conditions rule, the engineer—let alone the layman—cannot take full advantage of the Exhibition. The goods are there, and it should be a simple but very necessary matter to display them to the best advantage. The general arrangement is good, but the all-important points of what and how and why remain to be driven home by showcards. The electrical industry in the past has not been shy in the preparation of showcards for the use of the trade. It has plenty of men who can produce what is wanted in this class of work, and in a few days stands that are at present speechless may be made eloquent by pictorial and other showcard publicity. It is surprising how easily the layman grasps the main facts and principles of technology, and, in these days of specialisation, the expert in one branch of engineering will be thankful for elementary information in another.

How to Keep "Fit" at Wembley.

The only way to keep "fit" and efficient for the whole length of the Wembley run is to adopt and adhere to very definite plans fixing when it is best to keep away from the show. While a stand must be well manned all the time if one is to keep one's good name and utilise every opportunity for adding to one's business connections and reputation, this must be done, as we have already said, according to a plan which allows assistants to secure relief; but that plan must also enable principals and important officials of exhibiting firms and companies to feel free to remember that, after all, the exhibition is only *one* of the calls upon their time. Those who have control over their own movements and the movements of others would do well to remember that the week-end is hardly the time to expect such men to be available unless on very special occasions. Many of them will have to come up from different parts of the country and will desire to keep their Saturday and Sunday free for duties and relaxation away from the Palace of Engineering. Indeed, it is tolerably certain that Saturday will be the one day of the week on which the general public from in and around London will be in evidence by the hundred thousand. While it is most desirable that these should find their way into the E.D.A. corner in particular and into the Palace of Engineering generally, it will not be the most convenient time for technical men either from home or from overseas to receive full attention and the best information. Those who can be there on other days of the week should do so both in their own interest and to lighten the obligations of men who, however anxious they are to be boosting their business all the time, must have some regular and definite time when they will be free from the Wembley clatter.

Power Transmission Lines.

Last year we published a series of articles by Mr. W. T. Taylor on the development of water power, which contained much entirely original matter, and a number of diagrams with the aid of which the work of calculation could be minimised and a great deal of time saved. Mr. Taylor has now undertaken a similar task with regard to that part of the power transmission problem which is still more directly interesting to the electrical engineer—namely, the determination of the various factors which affect the economic characteristics of the transmission line itself.

The author, in the article which we publish to-day, starts with the size of conductor, and shows that it must be *determined* (not assumed) before the length of span between the line supports can be settled, and that it is best to determine the size of conductor from a knowledge of the percentage power loss that the particular line can bear; a chart is given with the aid of which this information can be obtained. In Part II both the line voltage and the spacing of the line conductors are determined (not assumed), and a formula is given. In the author's formula for line voltage he omits the cost of energy, but takes account of the distance and kVA capacity. An original chart will also be given for finding the line reactance for any spacing of line conductors met with in practice. Part III will deal with the questions of power loss and voltage drop, and will include charts based on line reactance and resistance, with practical examples fully worked out. Part IV

will take up the question of the new regulations issued by the Electricity Commissioners and the mechanical design of overhead power lines, and will give several charts based on 8.0 lb. wind pressure, plus ½ in. radial ice coating on the conductors. Part V will treat of factors of safety and the choice of line supports and their sizes, and will include a chart for finding the size of line supports. Finally, Part VI will deal with the question of costs, and will give a chart for obtaining the size of conductor based on the cost of conductor and different percentages of power loss.

The series will be thoroughly practical throughout, and will present much information derived from the author's extended experience in electric power transmission engineering which has not hitherto been published. Many practical examples will be worked out in detail. Mr. Taylor's experience is international and of long standing in connection with big work, and the information that he gives in this series should prove useful to many of our readers.

The World Power Conference.

Full particulars have now been issued regarding the first World Power Conference, which is to be held at the British Empire Exhibition in July, and are reviewed elsewhere in this issue. The details given in the long programme of papers to be submitted make it clear beyond all question that the proceedings will be conducted on a scale without precedent, and that an enormous mass of information will be made available to the engineers who are responsible for the utilisation of the power resources of the world; and the itineraries of the various tours that will follow the Conference indicate that those who are privileged to take part in them may look forward with confidence to the most memorable and impressive experience of their lives. The papers will not be read; they will be issued in advance, and the subjects with which they will deal will be discussed at sessions set apart for the purpose, thus ensuring that the time of the delegates will be used to the best possible advantage.

Each of the tours outlined—in Great Britain, in South-West Europe, and in Scandinavia—presents so many attractions that to make a choice between them will be a matter of no small difficulty; but as they are concurrent, a decision must be made. Those who took part in the pre-war tours organised by the Institution of Electrical Engineers know well how delightful they were, and may judge for themselves how enjoyable the Conference tours will be.

The arrangements that have been made appear to be in all respects admirable and worthy of the importance of the occasion, which is heightened by the observance of the Kelvin centenary; and they reflect the greatest credit on the organising director, Mr. D. N. Dunlop, and his staff, to whom our cordial congratulations are due.

Division of Profits and the Question of Costs.

Sir Arthur L. Dickinson, F.C.A., recently read a paper before the Royal Statistical Society on the subject of Publicity in Industrial Accounts, in which he touched on one of the greatest problems of our industrial life, namely, the proper apportionment of profit between capital, management, and labour. In describing British and American methods of issuing financial statements of the operations of industrial and commercial concerns, including public utility services, banks, and insurance companies, Sir Arthur showed in what respects many of the returns were inadequate. The general conclusion drawn was that only in the case of public service, transport, gas, electrical, &c., industries, were really complete and detailed accounts available to the public. The volume of data published in this country regarding coal production, and in the United States regarding iron and steel manufacture, was, however, commended. But, said the author, it seems useless to expect that any really stable conditions can exist until further information is available in each industry, showing the costs and proceeds of sales of the products, and so enabling the arguments between the parties to take the form of a discussion of a fair division of the net proceeds. There will be general agreement with Sir Arthur's suggestion that modern industry is in effect a partnership between the capitalist, the management, and labour, although it must be remembered that the first two of these may comprise numerous services of varying value. For this reason, while accepting his view that the margin between selling price and cost of production should be divided between the three partners mentioned in proportion to the contribution of each, we are not sure that he realises the magnitude and difficulties of the problem which has to be solved. More is needed than the supply of details of the cost of the product or service or the resulting profit.

Behind the term "Capitalist and management" there is frequently a force, the value of which is often inadequately appreciated by labour and its leaders. We mean the initiator of an enterprise—the *entrepreneur*—the man of foresight, inventiveness, perhaps one who makes a great scientific discovery or who organises a new method of manufacture or distribution. He is seldom a capitalist. He must have sufficient confidence in himself and must inspire enough confidence in others to induce those with capital to risk their money. If he succeeds he may be the means of providing employment for thousands. If he makes a mistake, he and his associates lose heavily—in reputation or in cash. In the former case, who can judge how his reward shall compare with that of the workman who risks relatively nothing at all? Points such as these—if not appreciated already as, we fear, they are not—need to be explained to the trade unionist by means other than statistical tables and financial statements.

The factory hand, who may be able to ascertain, with the help, perhaps, of the foreman or the delegate, the approximate cost of material and labour that enters into the production of an article, say a metal-filament lamp or a small motor, is inclined to talk wildly of profiteering when he finds out that the finished article sells at a good deal above what, as far as he knows, it has cost in the making. Does Sir Arthur Dickinson propose to reveal to him and to the public generally the itemised costs of all the additional factors that make up the selling price, *e.g.*, the expenses of selling, advertising, taxation, patent fees, perhaps fighting patent actions, product which must be scrapped, and, further, that most elusive factor, the cost of going after business that ultimately falls into other hands? We fear that the engagement of a large staff of super-accountants would not of itself bring industry to that goal of harmony which we all desire should be reached.

The I.E.E. Report.

The Institution of Electrical Engineers is to be congratulated on the excellent report and statement of accounts submitted by the Council to the annual general meeting last week. After a period of difficulty, when the outgoings threatened to overtake the income, an era of renewed prosperity has opened, and a substantial credit balance has been recorded. The membership continues to increase at a rapid rate, and the amount of work turned out by the numerous committees shows no diminution; moreover, the coveted title of "chartered electrical engineer" has now been secured for the corporate members, and the subscriptions have been appreciably reduced. No wonder, then, that even Mr. F. W. Purse, keen critic as he is, had nothing but kind words for the Council. Mr. W. R. Cooper, however, touched a very sensitive spot when he drew attention to the very unsatisfactory illumination of the I.E.E. lecture theatre. It is a standing reproach to the profession which boasts of so many illuminating experts that the theatre of its leading Institution should continue to be an object lesson showing how lighting should not be done. The Council should see to it that, before any visitors from overseas arrive for the World Power Conference, an adequate and tasteful illumination scheme is brought into operation.

Power Transmission Lines.—I.

Aspects of their Design.

By WILLIAM T. TAYLOR, M.Inst.C.E., M.I.E.E., Fel. A.I.E.E.

It is usually understood that the statement which defines Kelvin's law was intended for the bare conductor of d.c. circuits and did not include the line as a whole. The most economical line involves four extremely important factors, namely: (1) The most economical line conductor; (2) the most economical span length of line supports; (3) the most economical line voltage; and (4) the most economical phase compensation. A line conductor is the energy conduit, but there is a law applying to all energy conduits. That is to say, *when the total annual cost of the energy conduit (air, steam, water, electricity, &c.) is equal to the cost per h.p.-year to the supply undertaking, plus the cost of wasted or lost energy, the most economical conduit is obtained.*

The power lost in a line, if made available by putting in a larger line conductor, could presumably be sold at the same price as the power already sold, so that we can say: the most economical line conductor will be the one which is so laid out that an increase in the amount of metal would cost more in interest, depreciation, &c., than the increased power could be sold for, and at the same time that a decrease in the amount of copper would reduce the interest charges a less amount than the added power loss would reduce the income. Now, in actual practice, the transmission system is not operated at a given load at all times—although the line is designed on the basis of a given set of conditions more or less fixed in value—the maximum number of kW-hours is lost at the time of maximum load *carried* and the total amount of actual energy that is lost or wasted will be determined by the average kW-hours lost or wasted. Also, if the power lost be reduced, and the energy thus saved be sold, it will be necessary to have larger plant at the station, and this will increase the total cost and the annual charges; on the other hand, the full amount of power thus saved can seldom be sold for the full 24-hour day. It will be evident that the interest charges on the total line conductor investment are quite independent of the actual load on the line. At the time of electrical design it is very essential to give the fullest consideration to future increase in plant capacity and to the probable time-period of load growth.

The loss of energy in a circuit during the year is dependent upon the load factor of the load carried, and, in calculating line losses, an appropriate full account should be taken of the load factor of the plant and of all other conditions affecting the total losses. For a new line and load, results are rarely possible within any close degree of accuracy; usually for a line extension it is an entirely different matter. As will be explained in the articles to follow, the amount deducted as annual line expense from the gross plant income is made up largely of factors that are fixed regardless of the amount of power transmitted, but the main question is the proper value of these factors, which are: the interest on the money actually spent in the line, and the percentages allowed for depreciation, maintenance, taxes, &c. (See Part IV of this series.)

For a given size of line conductor there is a theoretical line voltage which gives the minimum losses through heating; for too low a voltage we may find that the losses from "*watt*-current" are too great, and for too high a voltage the losses from "*wattless*-current"* may also be too great.

For such lines as we have in this country at the present time, we may take the losses in a given conductor as being inversely proportional to the square of the line voltage—not strictly the case for the greater transmission distances and the higher line voltages of the future. For all the bare overhead power transmission lines of this country, the effect of charging current in the line can generally be omitted in line calculations. However, in future we shall have to deal with the transmission of power over much greater distances and at much higher voltages, and the charging current may interfere seriously with the transmission system efficiency. On the other hand, since a charging current will tend to balance the lagging component of the load current, it is helpful in raising the power factor at the generating end of the line, and thus tending to reduce losses and cost. For a given line, "*leading energy*" is practically constant, since it depends only on the line voltage.

If a line voltage is chosen which makes the "*wattless*-current" equal to the "*watt*-current," we shall have an example of maximum efficiency; but a further increase in line voltage will decrease the "watt-current," while increasing the charging current, hence, the resultant current will be increased. The condition of balanced out-of-phase energy is established when $E/I = \sqrt{(L/C)}$; this condition can be reached for any line and voltage by properly choosing the current, and for any current by properly choosing the voltage. Obviously there is some limiting line voltage (neglecting the effect of corona and leakage, &c.) beyond which any increased efficiency is impossible. It is also evident that if we keep the same line voltage but double the transmission distance, we shall also double the charging current. And, if we lower the line voltage and increase the "watt-current" we are likely to encounter other conditions equally as bad or worse. We may increase the size of line conductors, and at the same time find it necessary to work with a lower line voltage than before and with greater line losses. It would therefore seem that, so long as the length of transmission line exceeds certain limits, charging current will present the most difficult and may be *the* most dominating factor. Moreover, with a heavy charging current, the effect of inductive reactance may be more harmful to the system, and, if the kVA capacity and distances are increased greatly, we may expect even greater disturbances and closer resulting power capacity limitations from the effect of line inductive reactance. In so far as this country is concerned, these conditions refer to the bigger overhead power transmission lines of the future.

The problem of designing a circuit—the common kind of to-day—is often one of determining what size of conductor should be used to limit the line loss to a specified amount when distance, load, and current are known, and also determining whether the size required for the given *normal* line voltage is sufficient to carry the maximum permissible current to conform with accepted good practice; this latter condition is dependent upon whether the conductor is installed in open air, in conduit, or underground. This article relates exclusively to the first location, *i.e.*, a bare conductor in the open air.

The diameter of a conductor varies directly as the per cent. energy loss, and, for a given per cent. energy loss, the cross-section of a conductor varies inversely as the square of the line voltage; also, the energy taken by the capacity of the line varies as the square of the voltage, so that this factor is of extreme importance in the case of high voltage lines. Considering the size and weight, a conductor varies directly as the square of the distance of transmission and directly as the kW load, and inversely as the square of the power factor and line voltage and inversely as the per cent. energy

*In the ordinary three-phase system it is usual to take the total wattless volt-amperes as the algebraic sum of the wattless volt-amperes, and the total energy volt-amperes as the sum of the energy volt-amperes in each of the three single-phase paths of the system.

loss. For a circuit of short length, the carrying capacity of the conductor will frequently determine its size and not the economic line power loss. For overhead electric power lines such as are found in this country, the line power loss (as based upon the theory of transmission lines) becomes simply equal to the load current (I) power loss. The line voltage and, of course, the size of conductor, are dependent (among other factors) on the permissible power loss and the transmission distance. If the delivered power be fixed, then the line current will decrease directly with the increase of line voltage. Knowing the power loss and distance, the size of conductor for a three-phase circuit can be determined from the formula: $R = 1/3\ [(\text{kW loss})/(I^2)]$ ohms... ... (1) wherein R is the total conductor ohmic resistance at a given temperature, usually ranging between 15 deg. C. and 25 deg. C. Dividing the value of R by the distance in miles will give the resistance per mile of single conductor, and when this is known, the size of conductor can be obtained directly from Chart 1. The total kW loss can be determined from formula $p = 3\ I^2 R$ . . . (2), and the percentage power loss from formula $p' = (p/P)\ 100$ . . . (3)

Since a change in the value of R due to a change in temperature, as also a change in the power factor of the load, will alter the line power loss, it is evident that to include the many possible variable values would require a very large and rather complicated chart, and because of these disadvantages would not be so useful as a simple chart such as the one presented herein. The best that can be done is to present a chart to satisfy ordinary circuit conditions and to base it on a commonly accepted conductor temperature and plot it in such manner as to obtain the desired information for load power factors commonly encountered in practice. Since losses are expressed in percentage of the power and are dependent upon R, they are accurate for any frequency and spacing of line conductors for all the sizes covered by the chart.

It is of no use choosing, guessing, or assuming the size of conductor in a haphazard way, as invariably the requirement is to know, within practical accuracy, the cost of conductors and also the power loss for a given set of conditions commonly forming the basis of line design. One of the most practical ways of finding the size of conductor —which must be known before the span-length of line supports can be determined—is by ascertaining the market cost of metal (line conductor) and assuming a reasonable power loss, in fact these are the two most important independent and inter-dependent variables which must be ascertained before the most economical conductor is known. A common practice is to assume or guess at the size of conductor and then find the allowable drop or loss. It will be seen from Chart 1 that the cost of line conductor varies inversely as the loss expressed in per cent. For values of power factor different from unity, which is the basis of the chart, multiply the values obtained from chart by $(\cos \phi/100)^2$, wherein $\cos \phi$ is given in per cent. It is usually known what loss a line can bear, and 10 per cent. is a very good mean. This therefore is the factor to assume, and not the size of conductor.

When the size of conductor has been determined, the total cost of conductor is at once obtained by multiplying the transmission distance in miles by the cost values given in the chart. Hence, the chart values give the size of conductor and its cost, these being the information sought. These values have been worked out in Chart 10 to cover different percentages of power loss, &c. When the size has been determined in this way, a preliminary calculation should then be made by the method given in a forthcoming article, to ascertain what line regulation may be expected or what power loss and regulation can be expected for the nearest commercial standard size of conductor. All charts are based on the legal standard wire gauge (L.S.G.).

If it is required to ascertain the size of conductor for a given power loss, use formula:

$$p' = (p''/k)Pl \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

or conversely, if it is required to ascertain the power loss for a given size of conductor, use the formula:

$$p'' = k(p'/Pl) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

wherein l = transmission distance in miles.

p' = power loss in per cent.

P = kW delivered (per 1,000 kW).

$k = (\cos \phi/100)^2$.

p'' = power loss per mile per 1,000 kW (obtained from the chart).

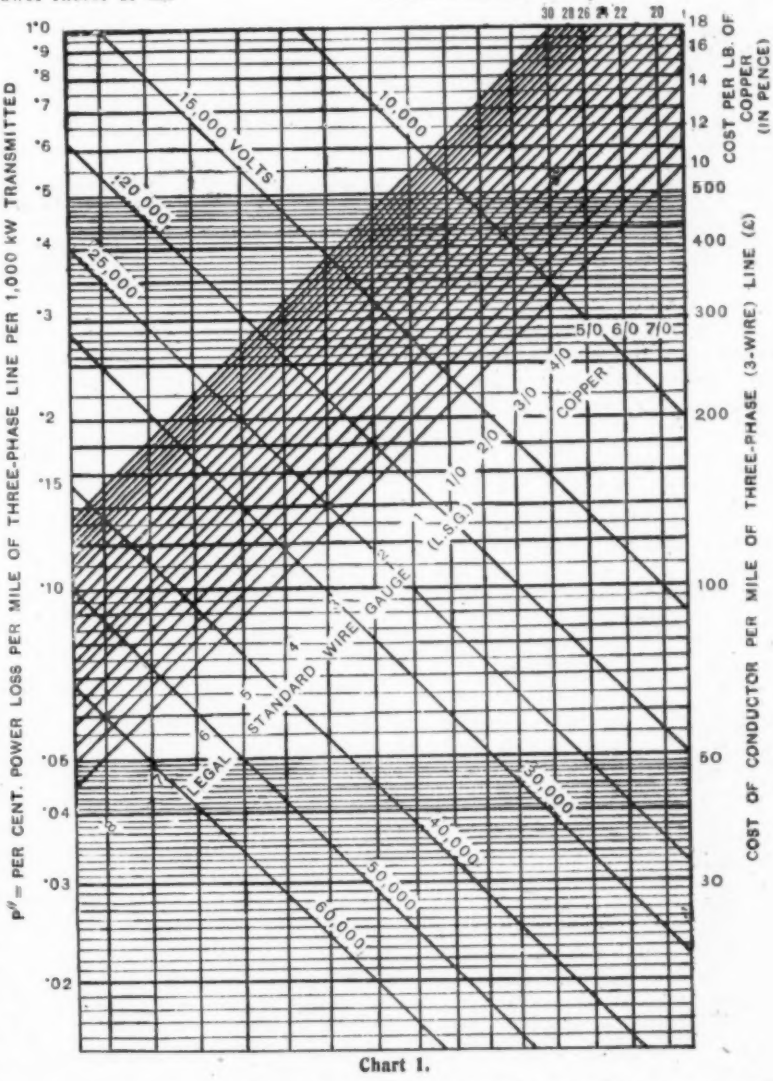


Chart 1.

Example 1.—A load of 6,000 kW at 80 per cent. power factor is to be transmitted 50 miles over a three-phase bare overhead line at 40,000 volts to a group of mines with an energy loss not exceeding 10 per cent. Find the size of conductor.

With a power factor of 80 per cent. we have $k = (80/100)^2 = 0.64$. Then, percentage power loss per mile per 1,000 kW delivered is—

$$0.64 \times (10 \div 6 \times 50) = 0.02112,$$

E

having this value now follow the 40,000-volt line to the intersection of value $p''=0.02112$ on Chart 1, we find the *nearest* commercial standard size of conductor to be No. 4/0 L.S.G. bare hard-drawn copper. (Also see Chart 10).

The converse can be obtained—that is, the percentage power loss—from a knowledge of the size of conductor. Assume a No. 4/0 bare hard-drawn copper wire, then, for 40,000 volts between conductors of this size, we find a value of 0.0215 per cent. power loss; hence

$$p=(0.0215\div 0.64)\times 6\times 50=10.1 \text{ per cent.}$$

With copper selling at £112 per ton (12 pence per lb.), the cost per mile of line for conductor is seen to be £380; hence, total cost is $380\times 50=$ £19,000 for 50 miles of three-phase line.

Example 1*a*.—Now take the same example and assume the same percentage power loss, but let it be required to find the size of conductor for unity power factor, and to compare the relative cost of this with load of 6,000 kW at 100 per cent. power factor.

In this case the percentage power loss per mile of line per 1,000 kW delivered is $10\div(6\times 50)=0.033$.

From Chart 1 the *nearest* size of conductor corresponding to a pressure of 40,000 volts and $p''=0.033$ is seen to be No. 1/0 L.S.G.

Following this vertical value to the intersection of cost per lb. of 12 pence, we find £250 as the cost per mile of three-phase line using No. 1/0 L.S.G. copper wire. This makes a difference of £6,500 in favour of the higher power factor for the 50 miles of line, which is equivalent to an additional length of 26 miles of three-phase line.

The inverse can be obtained— that is, the size of conductor—from a knowledge of the cost of copper, but this does not give any idea of the line voltage, load, transmission distance, &c.; hence the latter-mentioned part of the chart is actually applicable only to the cost of copper per mile of three-phase line.

Chart 1 can be used for any line voltage by multiplying the chart values of p' by $(E/E')^2$; wherein E' is voltage taken directly from the chart, and E is the voltage for which it is required to determine the size of conductor. Only one voltage (standard or otherwise) need be plotted; however, in order to give greater simplicity in calculations, standard receiving end voltages have been plotted.

Example 1*b*.—Assume the same load in kW delivered, transmission distance, percentage power loss, system, and a load power factor of 100 per cent., but let line voltage E be 60,000 volts.

As already shown, $p''=0.033$, therefore p'' for the new line voltage at receiving end is—

$$0.033\times(60{,}000\div 40{,}000)=0.05.$$

Following the diagonal voltage line for 60,000 volts to the intersection of $p''=0.05$, we find size of conductor to be No. 7 L.S.G. Also, for a 30,000-volt line, we have—

$$p''=0.033\times(30{,}000\div 40{,}000)=0.0248;$$

hence size of conductor is seen to be No. 7/0 L.S.G. hard-drawn copper wire.

Why Not Allow Rebates Instead of Charging Extras?

By E. G. ROSS, A.M.I.E.E.

How often do we hear the complaint: "I would really buy a fitting like that, but there seem to be so many extras necessary to use it properly that I can't afford the thing"; or, again: "We really cannot spend so much money on these extra parts; order up that other gear"; or, once more: "Oh! we won't bother about that new machine just now; we'll just run up the old one to its fullest limit and save the new accessories."

Such complaints are of hourly occurrence, and while the electrical salesman swears gently (?) under his breath when he hears them, he knows that the sentiment expressed is only too true in substance. The retailer is painfully aware of loss in sales and prestige due to the "jibbing" of prospective customers when he points out, as tactfully as he can, that "such and such is needed, together with so and so, before you can use the fitting, in addition to which you will, of course, require lamps. We also charge 3s. per hour for our man's time and expenses wiring it up for you"—or some such equivalent story. After hearing this, it is hardly surprising that the customer becomes "fed up" and finally decides to "leave it for the present," taking his departure with a feeling of annoyance with the contractor and with electricity in general. Indeed, his faith in "electricality" may be badly shaken, if not destroyed, to the attendant loss of the industry. Again, it is now a common experience to hear one's best customer say: "You'll need to throw in the starter with the motor at the same price if you want the job." Many more equivalent instances could be cited, but those mentioned will suffice to indicate the trend of modern electrical commercial dealing.

There appears to be something wrong with it all somewhere, but just where is the trouble.

Turning over some notes on "fruitless quotations" during the period 1921 to date, an analysis of these revealed to the writer the following peculiar, yet very significant, points: Referring to the majority of cases—

I. All kinds of customers were quoted, *i.e.*, contractors, factors, users, &c., but the main customer was the non-technical user.

II. The tenders each comprised one large item and many small ones, *e.g.*:

1 "X"-kW dynamo.
1 control panel.
1 ammeter.
1 voltmeter.
Tubing, cable, and sundries.

or, again,

1 3-kW electric fire.
"a" ft. cable.
1 main switch.
2 fuses.
Man's time, &c.

III. All prices were quoted "delivered on site" or its equivalent.

IV. *Total price* was the deciding factor with the buyer as distinct from prejudice to any given maker.

V. The *main item* of the tender was invariably favourably considered.

VI. Erection on site did not appear to matter.

VII. Delivery time, although of certain importance later, did not materially affect the placing of the order.

VIII. Only a few lower tenders were rejected on technical grounds, other things being equal.

IX. Travellers and agents, calling later, were very largely discouraged and generally avoided.

These informative points being noted, "effective quotations" were then surveyed over the same period, and similarly, some surprising facts were observed. Three only of these will, however, be here referred to. These are—

X. In the rare cases where a lump sum was quoted in order to get over the difficulty of sundry commissions, and allowances for unforeseen extras, the tender was accepted almost without question.

XI. Approximately 75 per cent. of the tenders covered a main item, plus subsidiaries, and of these the main item was nearly always ordered.

XII. The subsidiaries were rarely ordered.

Reflecting on these somewhat remarkable points, it is obvious that some reason must exist for their presence in so many tenders, and if they are carefully considered in conjunction with the aforementioned complaints, much that is of great value is soon made manifest. Primarily, the business dealt with was largely with non-technical users, who, it would appear, preferred the price to be quoted as "delivered their address," and to whom the *total price* appeared to loom greatest, apart altogether from a "use and wont" prejudice. Further, as they considered the main item of the tender most favourably, this indicates that they were prepared to spend a certain large sum at least on the material they inquired for, but that they did not appear to have, in their own minds, any predetermined figure to work to. That is to say, they knew that they required (say) a source of power to operate their plant, but they failed to comprehend the importance of the smaller items. This is evidenced by the fact that erection and efficiency, &c., did not count as deciding factors on the whole. Even delivery did not affect their decisions very much. It is important to note this.

Again, and what is probably most significant, they did not care for men calling to push them to a decision in the matter, from which it will be inferred that they infinitely preferred to digest the written quotation in, and at, their own time.

From the foregoing it will be seen that the importance of the written price cannot be overestimated, and it is further apparent that the usual methods of quoting or pricing do not seem to make that forceful appeal to the buyer's intuition which is at once most desirable and essential, the more so when, as many must admit, customers generally "plump" for "something for nothing." Which brings us right up against "the great inherent" in human nature, the importance of which is far too often ignored. Every day we come into touch with the man who wants something for nothing, but instead of finding out why he does so want, we generally ignore him, or else give it to him with a grudge and much inward grousing. This is not the correct thing to do. Since the tendency to "grab" undoubtedly exists in point of fact, it behoves us not to thwart it, but to make use of it, converting it into a kinetic, business-getting, or rather, business-giving propensity. In brief, why shouldn't it be catered for in the first pricing of an article? If a man wants a reduction, why not let him have it? Such would only be meeting him in a spirit of practical service, which would appeal to him very greatly. Obviously also, if a seller says to a customer that he can give him a reduction instead of adding extras, the customer is far more likely to lend a kindly ear to the proposition. The truth of this is clear and very potent. Further, the ease of doing so is much greater than at first appears to be the case.

It will be realised, then, from the above, that the present method of quoting *should be reversed*. An example or two will make this idea quite clear, having regard to the "price appeal" only. As all prices and quotations vary in the actual service attendant thereon, the main part of the examples only will be considered.

Two typical examples of "usual method" quotations are—

(A) In response to your esteemed inquiry of ——— inst., we beg to quote for

1—X kW battery-charging dynamo to give Y amps. at Z volts when driven at W r.p.m., with standard bare shaft extension.

Price, dynamo alone	£A A
d/d your address.	
Extra for pulley	£B
Extra for slide rails	£C
Extra for shunt regulator	£D
Extra for ammeter	£E
Extra for voltmeter	£F
Extra for mounting switchgear on panel	£G

&c.

(B) In response ..... quote for—

1—X-type fitting, List No. ——, with lampholder, ceiling plate, and counterweight, suitable for

1 "Y"-watt lamp	A/-
1—red silk shade	£B
Extra for lead shot	C/- per l...
Extra for flexible cable	D/- per yd.
Extra for 2-light fitting ...	£E
Extra for 3-light fitting ...	£F

&c.

In these examples it will be seen that the extras are each small in themselves, but large in total. Consider now these quotations "in reverse"—

(A_1) In response ..... quote for—

1 set — equipment suitable for charging a battery of ——— capacity requiring a maximum current of Y amps. and a maximum voltage of Z volts, and comprising 1 — X-kW dynamo, complete with pulley, slide rails, and control panel.

Price ... ... £H H complete, d/d your address.

Less £J if pulley is not required.
£K if slide rails are not required.
£L if regulator is not required.
£M if ammeter is not required on panel.
£N if voltmeter is not required on panel.
£O if control panel, complete, is not required.

&c.

(B_1) In response ..... quote for—

1 — 3-light fitting, suitable for the lighting you require, complete with ceiling plate, counterweight, shade as chosen, lead shot, flexible cable sufficient for a drop of 6 ft.—the whole wired up in place and lamps fitted.

Price ... ... £H H complete.

Less J/- if ceiling plate not required.
K/- if lead shot not required.
L/- if flexible cable not required.
M/- if only 2 lampholders are required.
N/- if only 1 lampholder is required.
O/- if you will wire fitting in place yourself.
P/- if lamps are not required.

&c.

It will be seen that the second method of quoting has certain definite advantages when considered in relation to what has been said regarding the review of the aforementioned "fruitless quotations." Some of these are:

(*a*) To the non-technical user, the new method has a *primâ facie* appeal of much greater force than the old method, since the first and most important impression it creates is that of a frank, free, and unfettered statement of the *total amount* which the buyer *must* spend to put in a *complete outfit*. In view of the previous considerations, this is a most valuable and important point. As soon as the non-technical user fixes in his mind a standard to judge the total by, then the battle for the order is half finished. It is pretty certain that when he reads the total of £H H, his mind will fix on that sum as a criterion of his expense, and, whether or not he may take umbrage at the amount, it is forced upon him that he must spend *not more* than this sum for a complete job.

(*b*) In doing this, a direct service is conferred upon the potential buyer, and it is suggested from experience that this fact will at least intuitively weigh largely with him. The cry to-day is for service all the time, and no effort should be spared to serve *first*, which is precisely what the new method of quoting does.

(*c*) By so creating a *first favourable impression*, the "use and wont" prejudice is largely undermined at the commencement—another most important point. It is the greatest task, as most of us know, to "get in" with a firm which has long held to one particular maker's goods. This prejudice is hardly fair in any case, and anything tending to counteract it is worth noting.

(*d*) The reverse method puts the onus on the buyer as to what he will actually require to buy to cope with his needs, and that in a most inoffensive way. There can be no question as to the interpretation of *what is offered*. It is well known that with non-technical users —aye, and with technical users as well—when it is found later that something has been omitted somewhere, the supplier is very generally blamed for the omission. Here, in such a case, the blame can only fall on the buyer, since, if he accepts the quotation, there is absolutely no doubt whatever to any mind that the suppliers are willing to supply *all* that is necessary to do the work required, and therefore, if something is omitted from the order, it cannot possibly be thrown back on *them*. The value of this aspect cannot be over-estimated.

(*e*) The *supplier's policy is laid open* to the buyer by the system of rebates for parts not required. A general feeling exists to-day that the supplier is out to sell all he can without attention to whether the buyer needs all he offers or not. The "reverse method" of quoting obviates the possibility of this feeling arising; so, when a buyer discovers that he does not require certain parts, he has only to say so, and be satisfied in his own mind without hesitation that they will neither be supplied nor charged for, all of which inevitably tends to stabilise matters.

(*f*) If, it being necessary to meet competition, say, the price must be adjusted later, this can be done under more favourable psychological conditions than by the old method. Which of the following is the better manner of reducing a price?:—"We will allow you 5 per cent. off our quotation of ( ) inst." or "We can let you have a further rebate of 5 per cent. on the goods you find it necessary to order." Undoubtedly the latter manner would make a much greater appeal to the buying mind than the former.

(*g*) On this basis, the agent calling later stands in a very much more favourable light than hitherto. If a firm does not satisfy from headquarters, it is axiomatic that its agents are regarded largely as interlopers, whereas, on the other hand, if the firm *does* satisfy, a much more genial interview awaits the caller. There is already in existence, probably needless to say, a feeling between firms and agents that a greater collaboration between them might do a world of good to the industry, and this collaboration would be aided very materially by the adoption of the "reverse method" of quoting.

(*h*) The foregoing shows that the new method is the ideal one for window ticketing. A ticket, already artistically attractive, but made more attractive from the point of view of the cash involved, must prove an effective silent salesman, the value of which is too well known nowadays to require accentuation. Such a ticket silently showing the service spirit, and laying bare the firm's price policy, must, of necessity, do a great deal towards building up a favourable first impression on the window-gazer's mind.

In conclusion, many other incidental (and it is the incidentals which count) advantages will suggest themselves to the reader's mind, dependent upon his particular vocation, but sufficient has been said to indicate—

(*w*) Wherein a serious defect is prevalent in the ordinary manner of pricing.

(*x*) Wherein this defect may be eradicated in a very satisfactory manner by merely reversing the present procedure in quoting.

(*y*) Wherein, by so doing, additional benefits are conferred upon the supplier.

(*z*) And, finally, but most important of all, wherein the supplier may *do a service* to his customer, and thus with an increase in prestige.

The Institution of Electrical Engineers.

Annual General Meeting.

THE fifty-second annual general meeting of the Institution was held on May 8th. In the absence of the president (who was representing the Institution at the Iron and Steel Institute) Sir James Devonshire occupied the chair, and in moving the adoption of the Council's report for the year 1923-24, pointed out that the membership totalled 11,415, the increase being 504, as compared with 636 during the previous year. The continued progress and prosperity of the Institution afforded much satisfaction, and the Council felt confident that it would be supported by all members in preserving the strict use of the title "chartered electrical engineer," which conferred an honourable distinction. The winding up of the old Institution, made necessary by the incorporation under Royal Charter, was effected on July 19th, 1923. The subscription of corporate members was reduced by 10s., and that of graduates by 5s., from January 1st, 1924.

Col. R. E. B. Crompton had been elected an hon. member; there were now ten hon. members. Honours and distinctions had been conferred on six members during the year. The War Memorial Book was in the press, and would be published shortly; 55 members died during the year.

A very large number of meetings of kindred societies had been held in the Institution building during the past 12 months; the Institution itself had held 408 meetings of all kinds, and premiums for papers read had been awarded to Lt.-Col. H. E. O'Brien, Messrs. A. Bachellery, P. E. Erikson and R. A. Mack, A. S. FitzGerald, Dr. H. M. Barlow, Messrs. H. Marryat, S. C. Bartholomew, Dr. A. E. Clayton, Prof. W. Cramp and Miss N. I. Calderwood, Messrs. F. J. Teago and E. A. Watson. Premiums had also been awarded to Messrs. Turner, R. H. Barfield, and C. E. Horton and E. B. Moullin for radio papers.

The attendances at meetings of the Centres and Sub-Centres had been satisfactorily large, and the Council had sanctioned the formation of a local Centre in China, with headquarters at Shanghai. The Wireless Section held nine meetings, at which 10 papers were read. During the session 13 informal meetings were held, being two more than last session. The average attendance per meeting materially increased. A very full programme of meetings, visits to works, and social functions was carried out by the eight Students' Sections now in existence, and the visit to Belgium and Holland in 1923 was extremely successful, 40 Students taking part in it.

The scholarships awarded by the Council numbered four and from the War Thanksgiving Education Research Fund (No. 1) one grant of £100 had been made. The award of the Coopers' Hill War Memorial Prize fell this year to the Institution, and the Council selected Mr. F. R. Combes.

The set of enlarged photographs of past-presidents had been hung in the Common Room.

During the year 268 books and pamphlets had been presented to the Reference Library by members and others, and 140 volumes had been purchased. An increase in attendance was recorded, the total number for the year being 2,590, of whom 178 were non-members, as against the previous highest yearly total of 2,526. From the Lending Library 2,232 books were issued to 897 borrowers, the corresponding numbers for the previous year being 2,213 and 814 respectively.

The Silvanus Thompson Memorial Library was formally presented to the Institution on May 31st, 1923. On the same occasion Mrs. Thompson presented an oil painting of the late Dr. Thompson, and the Finsbury Old Students' Association a bronze bust of him. The Institution was the possessor of a painting of Sir Francis Ronalds at work on a catalogue of his library, of which the Institution had the custody and use. The painting was presented by Mrs. Ormans, a great-niece of Sir Francis.

The number of applicants for posts registered on March 31st, 1924, was 114, as against a total of 120 last year. A classified register of members seeking positions, containing particulars of their training and experience, was available at the Institution offices, and the secretary of the Electrical Appointments Board would gladly put employers in touch with highly qualified electrical engineers. The Council earnestly hoped that members in a position to assist would not fail to make use of the register.

The amount of matter published in the *Journal* continued to increase, and was largely accounted for by the publication of reports of the Electrical Research Association, in particular several dealing with overhead lines. The net cost of printing and posting the *Journal* in 1923, after allowing for sales and the revenue received from advertisements, was £4,159 (1,536 pages), as compared with £4,604 in 1922 (1,002 pages), and £4,936 in 1921 (852 pages). As the number of copies printed increased from 10,200 in 1921 to 11,400 in 1923, the reduction in the net cost was most gratifying.

The physics volume of *Science Abstracts* for 1923 contains

184 pages more than for 1922; the electrical engineering volume contained two pages less. During the year the Committee of Management of the publication increased the revenue, with the result that the financial position was now satisfactory, and *Science Abstracts* did not appear in the accounts, as in the past, as a financial burden on the Institution.

The revision of the wiring rules had been completed, and the fire offices would accept the revised rules, which would in future be known as "Regulations for the Electrical Equipment of Buildings." It was hoped to publish the regulations before the end of June. The Council had published model conditions of contract for (*a*) the sale of goods other than cables at home when no erection was included in the contract; and (*b*) the sale of cables at home when no erection was included in the contract. Conditions of contract for export orders were still under consideration. The draft regulations for low- and medium-pressure and for high-pressure overhead lines were, with few alterations, approved by the Commissioners, and published in November, 1923. The Committee was now engaged in the consideration of the Commissioners' regulations for securing the safety of the public, and for ensuring a proper and sufficient supply of electrical energy.

The joint standing committee representing the Board of Education and the Institution had approved for this session 50 schools and colleges in England and Wales at which courses could be taken by students with a view to being awarded national certificates or diplomas in electrical engineering. About 450 candidates would sit for the final examinations on this occasion.

The director of the British Electrical Research Association reported that the membership of the E.R.A. had been materially strengthened by the addition as associate members of representatives of suppliers and large users of electricity. Progress had been made and patents applied for covering improvements. The Institution had increased its annual subscription from £300 to £500, and a corresponding grant was being obtained from the Government.

A large number of British standard specifications dealing with electrical apparatus and machinery were published during the past year. At the request of the Electrical Research Association, a committee had recently been set up to prepare a British standard specification for vulcanised fibre. Preparation of the electrical vocabulary was making steady progress.

The Committee of Management of the Benevolent Fund of the Institution reported that on December 31st, 1923, the capital account of the fund stood at £9,969, and the accumulated income at £1,622. The donations and subscriptions to the fund in 1923 amounted to £636. In 1923 52 grants were made to 21 persons, amounting to a total of £1,034.

After making provision for contingencies as in the previous year, there was a margin to the good on the revenue account of the Institution for 1923 of £3,957, which had been carried to the credit of the general fund, and compared with £862 in 1922, an increase of £3,095. Mortgages now stood at £14,801; the assets amounted to £130,437, against liabilities of £5,038, leaving a surplus of £125,399, which, in comparison with that of the year 1922, showed an improvement of £11,000.

MR. W. R. COOPER expressed satisfaction with the report, which showed that all was going well. They could now, he thought, afford to have the lighting of the lecture theatre improved upon, and he was not sure whether the library was being kept up to date.

MR. J. J. STEWART, with reference to the Electrical Appointments Board, remarked that although the Government Committee in connection with the Ministry of Labour had found posts for 7,000 ex-officers, there were still 3,000 such men in London alone who could find no work. Many of them were highly qualified, and were drawing large salaries before the war. Could not the Institution Board and the National Committee co-operate in order to help such men?

MR. F. W. PURSE remarked upon the poor attendance at the meeting, the only business one of the year. Those members of the Council and others who had obtained for them the privilege of using the term "chartered electrical engineer" should be congratulated and thanked. The Institution was represented on a very large number of committees, and those dealing with the wiring rules, model conditions of contracts, and electricity regulations had done solid useful work. He could find no fault with the report.

The chairman pointed out that the lighting of the lecture theatre was receiving attention.

Both the report and accounts were unanimously adopted.

MR. W. R. RAWLINGS moved a vote of thanks to the officers of the Institution, both at home and abroad, which was seconded by MR. A. H. ALLEN, and, on the motion of CAPT. R. J. WALLIS-JONES, Messrs. Allen, Attfield & Co. were re-appointed auditors.

Lanarkshire Hydro-Electric Power Bill.

A COMMITTEE of the House of Lords, presided over by the Earl of Clarendon, sat last week to consider a Bill for the incorporation of the Lanarkshire Hydro-Electric Power Company, and to confer upon it powers to utilise the falls of the river Clyde for the generation of electricity. There were a number of petitions against the Bill, one of which was lodged by the Lanarkshire County Council, which, with other local authorities and authorised undertakers, is to bring forward a scheme under the Electricity (Supply) Act, 1919, for the formation of an electricity district, and holds that the sanctioning of powers, at present, to enable the proposed new company to carry out its scheme is, therefore, inexpedient. The Gourock Ropework Co., Ltd. petitioned, on the ground that the utilisation of the falls by the new company would interfere with the power available for driving its mills, which are lower down the stream than the falls to be utilised. Other petitions were presented by riparian owners on the river, but these concerned compensation mainly, and in most cases agreement had been reached.

The falls to be utilised are near Lanark, about 20 miles above Glasgow. Mr. W. E. Tyldesley Jones, K.C., who explained the purpose of the Bill, said the promoters were Mr. P. J. Pybus, Mr. W. L. Hichens, Lord Meston, Sir Hugh Reid, and Mr. John Sampson, who are named as the original shareholders of the new company; they are directors of the Power and Traction Finance Co., Ltd.

There are three falls to be utilised. The upper falls are the Bonnington falls; the next, half a mile lower down the river, are the Corra Linn falls; and three miles further are the Stonebyres falls. The first and second falls are to be dealt with together. The Clyde falls, it was pointed out by Mr. Jones, suggested themselves to the Water Power Resources Committee, in 1921, as being falls which could be utilised with advantage, and therefore, the scheme started with the approval of that Committee. The scheme is as follows: At the top fall, the Bonnington fall, it is proposed to construct a weir across the river for the purpose of deflecting the water into a catchwater or intake. The water will pass through a tunnel half a mile long, and then will fall through steel pipes down to the generating station or power house which is to be constructed below the Corra Linn falls, and from which the water will be returned to the river. Counsel emphasised that every drop of water which entered the intake would be returned to the river unimpaired in quality and unaltered in quantity. At the Stonebyres falls, three miles further down, it is proposed to construct a weir across the river just above the falls to divert the water into an intake. The water will pass through a tunnel, about a quarter of a mile long, and, as in the previous case, will fall through steel pipes to the power house below and be returned to the river. From the weir at the upper falls to the point of the tail race of the turbines the fall will be 189 ft., and the fall at Stonebyres will be 94 ft. The scheme will provide plant of 9,000 kW in connection with the upper falls, and 4,000 kW at the lower falls, making 13,000 kW in all. The total cost of the works will be £240,000.

Difficulties arose as the result of variation in the flow of the water in the different seasons of the year. It has been found to be out of the question to erect large storage reservoirs higher up the watershed, impound the water there, and so get a more or less steady flow during the whole year, and the erection of stand-by steam-driven plant to provide for variations in the power available at different seasons would also be too expensive. The proper utilisation of the falls could only be effected in connection with an electrical distribution system which had steam power plant for generating energy. As a result, terms have been come to with the Clyde Valley Electric Power Company, in whose area the proposed works will be situated, to take the whole of the output of the generating stations of the new company. It was explained that if the Bill passed substantially in the form in which it was presented, *i.e.*, if the scheme was passed so as to be an economical scheme, the Clyde Valley Company was not only prepared to take the whole of the output of the generating stations, but was also prepared to find the whole of the money for their construction. But, if the Bill was materially altered and the scheme made uneconomical, it would not be prepared to do so.

There was a report on the scheme from the Minister of Transport, who saw no objection to the proposals, provided the engineering scheme submitted to the Committee proved to be satisfactory. The Electricity Commissioners, it was stated, saw no objection to the resources in question being utilised, but pointed out that the intermittent character of the source of power rendered it necessary for the undertaking to be associated with an undertaking possessing a supply generated by steam, and the Minister was advised by the Commissioners that it was desirable that any power of supply conferred on the company should be limited to a power to supply in bulk under some working arrangement with the Clyde Valley Company or similar authorised undertakers.

The capital of the company is to be £250,000 in the first instance, and it may be increased, by Special Order made by the Electricity Commissioners, confirmed by the Minister of Transport, and approved by resolutions of each House of Parliament, up to £400,000. There is also power to borrow up to half the issued capital, and with the consent of the Electricity Commissioners, a further half. Five years is allowed for the construction of the works.

In the petitions of Sir Charles Ross and Mr. E. B. Noble, owners of riparian rights, it was stated that the petitioners were prepared to apply, in the next session of Parliament, for an Order on the lines of the present Bill, and that they were entitled to the opportunity of applying for such an Order in preference to the present promoters, who had no riparian rights. Counsel pointed out that Sir Charles Ross had tried to launch a scheme in 1922, but had been unable to proceed with it.

The petition of the Lanarkshire County Council (which is the "local authority" under the Electric Lighting Acts) raises objection to a clause in the present Bill by which it is provided that Section 2 of the Electric Lighting Act of 1888 is not to apply to the new company's undertaking; that is the purchase clause, enabling the undertaking to be acquired at the end of 42 years by the local authority. It was pointed out by counsel that the large power companies, such as the Clyde Valley Company, had their powers in perpetuity. If the power of purchase by a local authority hung over their heads after 42 years, they had to begin putting money away out of revenue to provide for the difference between the purchase price which would be obtained at the end of 42 years and the capital spent on it. There was not the slightest doubt, said Counsel, that electricity to-day was costing consumers far more money than it would do, simply because of that purchase power. The petition also states that the Lanarkshire County Council, with other local authorities and electricity undertakers in the South West of Scotland, are shortly promoting a scheme under the Electricity (Supply) Act, 1919, for the formation of an Electricity District and the constitution of an advisory committee representative of the local authorities and authorised undertakers therein. The proposed area of the new company is within the intended electricity district, and the incorporation of the company and the authorisation of new generating stations, pending the constitution of the advisory committee, was inexpedient and inadvisable.

The Gourock Ropework Company objects to the promoters taking powers to interfere with its property compulsorily, and states that the powers asked for in the Bill would seriously injure the water supply on which the mills depend. The case of the promoters, however, is that they will not deprive the Ropework Company's mills of a single gallon of water, because that company's intake is below the point at which the water used by the promoters will be returned to the river.

Evidence was given by eminent engineers who had been concerned with large hydro-electric power schemes, to the effect that the present scheme was the most economical that could be devised for the utilisation of the power resources of the Clyde falls, and it was agreed that the scheme would not be economical unless carried out in conjunction with the Clyde Valley Power Company, as arranged.

The decision will be announced later.

The London and Home Counties Electricity District.

Commissioners' Third Inquiry.

(*Continued from page* 744.)

ON the resumption of the inquiry on May 6th the chairman (Sir John Snell) made his promised announcement on the points raised by Mr. Montgomery, K.C. (for Hornsey, Finchley, and Walthamstow), and said that, whilst not admitting that the proposals with regard to the technical scheme and the Technical Advisory Committee were *ultra vires*, the Commissioners were willing to make certain amendments in order to avoid litigation. It was, therefore, proposed to give any authority the opportunity to ask that its stations should be excluded from the technical scheme and that the establishment of the Technical Committee should be permissive on the part of the Joint Authority and not compulsory. Later in the day the chairman suggested the following words for Clause 8, dealing with the appointment of the Technical Advisory Committee, in place of the present rather long and detailed clause:—"The Joint Authority may appoint a Technical Advisory Committee or Board consisting of duly qualified persons to advise them on any technical matters that may be referred to them by the Joint Authority."

Sir LYNDEN MACASSEY again suggested that in his view it was *ultra vires* to make the appointment of a Technical Advisory Committee or Board a part of the scheme, whether compulsorily or permissive, but there was no disposition on the part of most of those appearing to quarrel with the new proposals, except that Mr. Montgomery asked for time to consider them.

In these circumstances consideration was given to the clauses of the scheme. The Draft Order as now submitted consists of what may be termed the Order proper, two schedules and four annexes, and consideration was first given to Schedule 1. The area delimited does not include the areas of those companies with bulk supply powers, such as the North Metropolitan Electric Power Co., the Metropolitan Electric Supply Co., and the West Kent Power Co. These companies, however, are brought into the scheme in that they have to prepare proposals for the full development of their areas within two years, and it is because they would thus be brought within a power company's scheme that the Hornsey, Finchley, and Walthamstow Councils are asking to be left out of the whole scheme altogether if they cannot be taken out of the power company's area and placed under the jurisdiction of the Joint Authority. It was announced on behalf of the Conference of Local Authorities that it was proposing an amendment to take all local authorities out of power company areas and place them under the jurisdiction of the Joint Authority. This at once made it evident that this part of the case will be a prolonged one if some other way out is not found, for the power companies regard this attempt on the part of the local authorities as an endeavour to tear up their Acts of Parliament. However, this part was postponed for the present, and first consideration was given to those authorities which desire to be left out of the whole scheme. The principal one was the Watford Urban District Council, whose case was submitted by Sir HERBERT NEILD, K.C., and supported by evidence by Mr. A. W. BARHAM, the borough electrical engineer. Watford appears to be sandwiched between the areas of the North Metropolitan Electric Power Co. and the Metropolitan Electric Supply Co., and yet is attached to the area of the Joint Electricity Authority for the purpose of the scheme. To link up with the area of the Joint Authority means carrying mains through the area of one of the power companies, and Watford asked to be left out of the whole business as it saw no benefit, but rather the reverse.

The Hendon District Council also asked to be excluded, but has not at present an Order, a supply being given by a company which the Council can purchase at certain intervals.

A considerable portion of the day was taken up with a discussion as to the constitution of the Joint Authority, and it soon became apparent that there was an almost hopeless divergence of opinion. Mr. TURNER (for the Conference of Local Authorities) asked that all local authorities should have joint representation and that the larger boroughs should not have seperate representation, as proposed in the Order. Immediately the representatives of quite a number of boroughs, which are members of the Conference, differed from this view, and one after another asked that their separate representation might be retained—if they were given it under the draft scheme—or that they should be given it if not. Then came the important question of the proportion of representation as between the different interests, and again the Conference of Local Authorities, this time with the assent of all its constituent members, proposed a change, *viz.*, that the local authorities should be given much greater representation, and the county councils, in particular, should have less. The companies asked for larger representation. Eventually the matter was left for the decision of the Commissioners, who, by the way, are not deciding any of these points as they go along. Finally, representation was asked for by the Electrical Trades Union and the Electrical Power Engineers' Association, and the former also asked that a fair wages clause should be inserted in the Order; Sir John Snell doubted whether this request could be complied with legally.

The day's proceedings closed with the handing in of an important amendment by the Conference of Local Authorities concerning the clause relating to the leasing of stations to the Joint Authority, which was discussed on Wednesday.

On the resumption of the inquiry on May 7th Sir LYNDEN MACASSEY made reference to a rumour which had been circulated that if local authorities asked to be excluded from the technical scheme, there was a possibility of the Commissioners indulging in reprisals against them in some way.

Sir JOHN SNELL said that the suggestion was utterly ridiculous and absurd. Thereupon representatives of different local authorities promptly repudiated any suggestion that they had been responsible for the circulation of this rumour, and the incident was allowed to drop.

MR. HODSON then moved an amendment to Clause 12 of the first schedule, which provides for the transfer or lease of local authority generating stations to the Joint Authority, the local authorities being compelled within 12 months to come into the scheme. It is to the principle of compulsion

that the local authorities strongly objected and, therefore, they moved the following clause to take the place of Clause 12: "Any local authority undertaker or undertakers within the district may by agreement transfer or lease to the Joint Authority any generating station or main transmission lines owned by them on such terms and conditions, and (in the case of a lease) for such period as may be agreed."

The argument put forward was that the Electricity Acts of 1919 and 1922 made any transfer of a local authority's power station voluntary; the clause proposed by the Commissioners departed from that principle and, it was stated emphatically, could not be accepted. There was considerable discussion on the point and, although Sir John Snell offered to remove the compulsory character of the clause, neither the Conference of Local Authorities nor Mr. Montgomery (for Hornsey, Finchley, and Walthamstow) would accept anything short of the amended clause, another argument put forward by Mr. Montgomery being that there was no reference in the Electric Lighting Acts to leasing, which the Commissioners proposed to include.

Eventually Sir John Snell agreed to delete the whole of Clause 12 from the first schedule, and promised to put forward something else.

MR. CRAIG HENDERSON, K.C. (for the London County Council) intimated that unless provision were made for leasing, legal difficulties would be introduced.

On Clause 13 of the first schedule, which deals with the technical scheme, there was again a long discussion, and it became apparent that the Commissioners were reluctant to leave the Order without something in the nature of a technical scheme, but Mr. Montgomery made it clear that he was still not willing to accept anything in the nature of a technical scheme in the Order, on the ground that the Commissioners would be taking upon themselves functions which the Electricity Supply Acts laid upon the Joint Authority; in other words, they would be limiting the action of the Joint Authority to survey the whole position.

The discussion proceeded for a long time, until eventually the chairman proposed that counsel should meet the Commissioners privately on the following morning and discuss the position. He indicated at various times that the whole intention of the Commissioners was merely to give the Joint Authority a lead in the direction in which it should proceed, but that the scheme should be entirely flexible, and he pointed out that it must not be overlooked that the final consent to any technical scheme must rest with the Commissioners. Incidentally, it was emphasised that at the inquiry in 1921 the technical scheme, as now in the Order, was understood to be agreed upon by all the principal parties. In reply several of the authorities said that they did not, in fact, give the technical scheme their support.

The rest of the day was spent in dealing with less important matters, so that the consideration of the schedule, clause by clause *seriatim*, had to be abandoned.

On the important outstanding proposal of the local authorities to be excluded from the areas of the power companies, and to be placed directly under the jurisdiction of the Joint Authority, MR. CRAIG HENDERSON (for the London County Council) reminded the Commissioners that in December, 1921, they issued a series of decisions, one of which was that nothing in the Order should interfere in any way with the rights of power companies, and he asked that this decision be adhered to.

SIR JOHN SNELL informed Mr. Hodson (for the Conference of Local Authorities) that the Commissioners would hear on Thursday morning what line of argument was to be taken in support of the amendment.

On Clause 20 of the first schedule the London companies objected to being compelled to send particulars of any proposed extensions, &c., to the Joint Authority, on the ground that the Joint Authority would have no jurisdiction in their districts.

MR. MONTGOMERY (for the Hornsey and other councils) contended that the whole clause was *ultra vires* because it would enable the Joint Authority to make representations direct to the Commissioners without the knowledge of the local authorities. Eventually the Commissioners cut out part of the clause, but intimated to the companies that at the moment they were not prepared to agree to their proposed amendment.

On May 8th there was a private conference between Counsel and the Commissioners in order to endeavour to remove some of the difficulties with regard to the inclusion of the technical scheme in the Order, and its compulsory adoption by the Joint Authority within a stated period. When the inquiry was resumed the Chairman announced that Clause 13 as originally drafted would be deleted and would be made to read: "that within 12 months after the date of the Order the Joint Authority shall consider and report to the Commissioners upon the technical scheme, set out in the Order, provided that the London companies shall carry into effect, so far as their areas are concerned, the part of the technical scheme in the Order which affects them." There were also a large number of detailed modifications to carry out this general idea that the hands of the Joint Authority shall not be in any way tied with regard to the technical scheme and that the local authorities shall have the last word as to whether their generating stations and transmission lines shall or shall not be transferred to the Joint Authority. Finally the chairman stated that it was proposed to state more precisely the responsibility of the London companies for carrying out the technical scheme—merely a question of wording. Most of the parties asked for time to consider the precise effect of the proposals indicated by the chairman.

MR. TURNER (for the Conference of Local Authorities), indicated that a meeting was being held that evening to consider the whole position. Mr. MONTGOMERY took it that the intention was to enable those local authorities which desired it, to be excluded from the technical scheme, and the CHAIRMAN agreed.

MR. KENNEDY (for the West End companies) raised a point as to the possibility of the new arrangement interfering with the jurisdiction, by the Joint Authority, of the London companies and also with the agreement between the companies and the London County Council; and that there would be no need, when the scheme went through, for the companies to wait to get to work before the Joint Authority either came into being or began to operate. The CHAIRMAN suggested that provision would be made for any matters of this kind to be determined by the Commissioners.

MR. TURNER (for the Conference of Local Authorities) then moved the following new clause to Schedule 1: "The areas of all local authorities within the district as are authorised undertakers are excluded from the area of supply of any power company within the district." It was not the intention of the Conference to place the power companies in any worse position than they were now. The argument turned upon the legal interpretation of Section 12 of the Electricity Supply Act, 1919, and Section 16 of the Electricity Supply Act, 1922, and Mr. Turner argued that, if the request were granted, the authorised distributor could then go to either the Joint Authority or a power company for a supply; at present the authorised distributor would be tied entirely to a power company. At the same time, the position of the power companies would not materially be affected because the Joint Authority might go to a power company and supply the authorised distributor in that way.

SIR HARRY HAWARD suggested that the Joint Authority would then only be acting as the middleman, and MR. TURNER argued that the local authorities regarded it as of very great importance that they should not be put in the position of being unable, under the scheme, to extend their own generating stations and being forced to place themselves in the hands of the power companies.

MR. MONTGOMERY (for Hornsey, Finchley and Walthamstow), in supporting Mr. Turner's argument, said that whilst those three authorities were not in the least averse to coming within the jurisdiction of the Joint Electricity Authority, they must be removed from the area of the North Metropolitan Electric Power Co. At present, however, it did not seem that even if they were excluded from the power company's area they would be brought within the jurisdiction of the Joint Authority in a practical manner, and that was what he asked should be done. The general argument was that under the scheme the price of electricity would be reduced, but some held the view that the whole thing was a gigantic imposture, and that the price of electricity would actually be increased. Some of the authorities for which he appeared held that view, and strong evidence in favour of it was the fact that at the last inquiry held at the instance of the Hornsey Council for extensions, the Commissioners accepted the view that Hornsey could supply more cheaply than it could obtain electrical energy from the North Metropolitan Power Co. It was in this sense that his case for exclusion from the power company's area was slightly different from Mr. Turner's, although he accepted Mr. Turner's argument as supplementary to his own. At the present neither Hornsey, Finchley nor Walthamstow were being supplied by the power company, and it was obvious that Hornsey, at any rate, could be "better served" otherwise than by the power company.

The discussion was interrupted at this point for the convenience of the London County Council's witness, who dealt with the agreement between the London companies and the London County Council for the purchase of the London companies' undertakings—apart from the power companies—which includes the new scheme for the adoption of a sliding scale of prices and dividends. MR. W. CASH, accountant, spent the whole of Thursday afternoon and the greater part of Friday in dealing with the draft agreement which, although accepted in principle by all the London companies, contains points of detail yet to be determined. Up till 1931 a standard price was to be fixed by taking into account the costs and charges as in the last completed year, before the ascertainment was actually made, and the details of the costs and charges were set out under 17 different headings. Provision was made for a Contingency and Special Purposes Fund, interest on debentures, loans, &c., interest on superannuation or pension funds, and dividends on preference capital, after which the amount of dividend paid in cash by the company on its ordinary shares for the year ended December 31st, 1922, was to be paid; plus an appropriate allowance at the rate of 7 per cent. per annum in respect of new capital (including premiums, if any) only employed during a portion of that year; plus 7 per cent. on the amount of cash (including premiums, if any) received after December 31st, 1922, in respect of partly-paid ordinary shares existing at that date; plus 7 per cent. on the amount of cash (including premiums, if any) received in respect of new ordinary capital issued—or, alternatively, an amount equal to

10 per cent. on the nominal amount (paid up) of ordinary share capital subscribed in cash at December 31st, 1922; plus 7 per cent. on ordinary share capital created by capitalisation of free reserves before or after December 31st, 1922; plus 7 per cent. on the amount of cash (excluding premiums, if any) received after December 31st, 1922, in respect of ordinary shares existing at that date or new ordinary shares issued for cash; plus 7 per cent. on premiums received on ordinary shares after December 31st, 1922, unless and until capitalised as a free reserve—provided that neither of the two above alternatives should in total amount to less than 10 per cent. on the nominal amount (paid up) of ordinary share capital outstanding at December 31st, 1922; plus 7 per cent. on the amount of cash (including premiums, if any) received after December 31st, 1922, in respect of ordinary share capital. Each company must declare which of the two alternatives it elected to adopt prior to fixing the standard prices, when the right of exercising the option would expire.

That was the scheme up to 1931, when the right of purchase would be suspended until 1971, and, instead of the scheme just described, which would give the companies anything over 10 per cent., after 1931 the companies would only be able to earn 7 per cent. on the nominal capital paid up on ordinary share capital subscribed in cash, plus 7 per cent. on the ordinary share capital created by the capitalisation of free reserves. In short, whereas the standard dividend up to 1931, which could fluctuate according to the price charged for electricity, would be a minimum of 10 per cent., after 1931 the minimum would be 7 per cent., and the reduction was justified by Mr. Cash on the ground that after 1931 the companies would, in the ordinary course, not have existed at all, and that the agreement for the suspension of the purchase rights of the London County Council would place the companies in a more stable position.

It was a somewhat involved scheme at the moment, but the London County Council and Mr. Cash, together with representatives of the companies, had been into all the details, and were agreed in a general sense, although with regard to the City undertaking of the Charing Cross Co. better terms were asked for by reason of the fact that the purchase terms of that undertaking were more favourable than those which applied to the others. It was proposed, for the purpose of arriving at the standard price, to sub-divide the supply under the headings of (*a*) railway and traction supplies, (*b*) bulk supplies, (*c*) street lighting supplies, after deducting expenditure specially relating thereto, and (*d*) supplies to private consumers, and it was with regard to the precise working of this arrangement that the position was not made very clear to the Commissioners, who asked that it should be further considered by the London County Council.

MR. CASH expressed the view that the companies should be relieved from the present maximum prices in their respective Orders. Indeed, that would be one of the effects of the scheme as it stood in the draft agreement. The sliding scale would only operate in one direction; the minimum dividend could not be decreased whatever the price charged to the consumer, whilst the dividend could be increased if the price to the consumer were reduced. If, after allowing for what had previously been arrived at as the standard price and also the minimum dividend, there was a sum to the good, it would be called the "consumers' benefit," and of this the consumer would receive five-sixths by way of reduction in the price, and the company would be allowed the remaining one-sixth for increased dividend purposes or reserves, at its discretion. Provision was also made for revision of prices.

On May 9th MR. CASH continued his explanation, saying that the underlying principle was cost plus remuneration for capital. If the cost was ascertained and the Commissioners were satisfied that the remuneration on the capital was reasonable, the result would be automatic, because the benefits arising from a reduction in price would go in the proportion of five-sixths to the consumer and one-sixth to the shareholder.

SIR HARRY HAWARD said the Commissioners would like to have something more definite than appeared in the agreement.

MR. CASH said, in dealing with the clause in the schedule relating to participation in surplus profits, that the companies had intimated a desire to introduce a co-partnership scheme, and the London County Council was in favour of that. However, one difficulty was that in 1931 the position, so far as the shareholders were concerned, would be an entirely new one, but the London County Council thought it would be unfair that the employés, who by their efforts had helped to improve the position, should, in the same way, lose any benefit which they had received up to 1931. At the same time, if the addition which the employés received were made a fixed addition to their wages after 1931, it might possibly tend to encourage slackness on the ground that even if the price did go up the addition which they had received prior to 1931 would remain. Therefore, it was proposed that any such addition should remain a variable figure dependent upon the surplus profits of the undertaking. At the same time, the benefit already obtained by the employés when the revision, so far as the shareholders were concerned, was made after 1931 was not to be prejudiced by that revision.

THE CHAIRMAN said it appeared to be considered just that a special arrangement should be made in the case of the City undertaking of the Charing Cross Co., but it could not be agreed how.

MR. KENNEDY (for the Charing Cross Co.) was not prepared to leave the matter at large to the Commissioners. He was prepared to submit a proposal to the London County Council and, if that could be agreed, then it could be referred to the Commissioners.

MR. CRAIG HENDERSON (for the London County Council) said that the Committee which had dealt with the matter had no power to do more than was embodied in the draft agreement, except leave it to the Commissioners.

THE CHAIRMAN said that either the Ministry of Transport, acting through the Commissioners, or the Commissioners themselves, would fix the standard prices.

MR. TINDAL ATKINSON'S point was that the terms were extraordinarily generous to the companies, having regard to the fact that they were being put in a "cast iron" position.

MR. CASH replied that the only alternative was purchase under the 1888 Act, and the companies might argue that they would be entitled to a very large sum in that event. Certainly the terms of the 1888 Act would require a great deal of discussion.

MR. TINDAL ATKINSON said that under the agreement as now drafted it would be possible for the companies to charge more than the standard price for lighting in order to supply more cheaply for traction or other purposes, inasmuch as the final standard price would be the average of the different classes of supply.

MR. CASH said that difficulty had occurred to him, and he would be pleased if Mr. Tindal Atkinson could suggest some suitable words to get over it.

At this point an application was made by the South Metropolitan Gas Co. for a modification of Clause 6 of the fourth annex, which, as drafted, it was contended, would enable the Joint Electricity Authority to supply gas, and went further as regards the laying of mains than did Section 15 (2) of the Electricity Supply Act, 1919.

SIR JOHN SNELL said that as a different construction could be placed upon the clause than the one the Commissioners intended, which was to give the necessary facilities to lay pipes for condensing water and similar purposes, the whole of Clause 6 of the fourth annex would be withdrawn. This removed opposition by the National Gas Council, the Metropolitan Water Board, the railway companies, and the Middlesex County Council to the same clause.

MR. JACQUES ABADY then submitted a clause, on behalf of the Metropolitan Water Board, asking for additional protection to that given in the Electric Lighting Clauses Act with regard to its mains, in respect of works carried out by the Joint Electricity Authority. Among the additional provisions was that 28 days' notice with plans should be given to the Water Board of proposed works, instead of three days' notice and no plan; also provision for recovery of damages where injury was caused to the mains and works of the Board. The Commissioners promised to go into the matter.

MR. CASH was then further cross-examined with regard to the agreement between the London County Council and the companies, and it was suggested that there should be power of inquiry into cases of hardship where a lighting consumer was, for example, charged a high price so as to enable the price to other consumers to be kept down.

SIR JOHN SNELL asked if the companies objected to the retention of the maximum price for lighting, and Mr. Cash said he was not satisfied that the maximum price was really a protection to the consumer.

Doubt was expressed as to the results of the method proposed for arriving at the standard price, and it was arranged that Mr. Sydney Morse should give evidence on the point later.

SIR LYNDEN MACASSEY, K.C. (for West Ham) pointed to the fact that under the agreement a local authority taking a supply in bulk was not included in the list of people who could go to the Commissioners for a revision of prices.

SIR HARRY HAWARD, referring again to Clause 3, dealing with standard prices, said that the more he thought over it the more it seemed to him to require further consideration. As it would take a long time to thoroughly thrash it out, he suggested leaving the clause a little more general and allowing the Commissioners to approve later a scheme after proper inquiry and conference with all concerned. It was a matter which could not be done in a hurry.

With regard to the authority that is to fix the standard price, which will have to be done, perhaps, before the Joint Electricity Authority comes into being, MR. CRAIG HENDERSON said that the London County Council would be pleased to act in an executive capacity in the meantime.

SIR HARRY HAWARD said that the anticipation seemed to be that the standard price would be fixed during the coming autumn, and as the Order would not receive the sanction of Parliament until August, there would not be time between then and, say October, to constitute the Joint Authority.

The inquiry was then adjourned until Tuesday, May 13th, the Commissioners stating that it would be impossible for them to sit on Monday.

(To be continued.)

New French Company.—La Société d'Electricité de Bourg Saint-Andeol is the name of a new company which has lately been formed at Lyons, with a capital of 100,000 fr.

The World Power Conference.

PREPARATIONS for the great World Power Conference that is to be held in July are now far advanced; a classified programme and a provisional time-table have been issued, as well as an account of the official tours which have been arranged to follow the Conference, and a list of the officials and committees at home and abroad, so far as these have been appointed to date. The president of the Grand Council is the Rt. Hon. the Earl of Derby, K.G., and the organising director is Mr. D. N. Dunlop; all communications should be addressed to the Secretary, World Power Conference, 36, Kingsway, London, W.C.2.

The purposes of the World Power Conference—the first of its kind—have already been set forth in our pages. The classified programme includes five divisions: I, Power Resources; II, Power Production; III, Power Distribution; IV, Power Utilisation; V, General; and these are further sub-divided into 13 sections.

The programme gives a list of the papers arranged to date, which emanate from some 27 countries, to the number of more than 300, of which a quarter are of British authorship. Naturally, in so huge a collection of papers, there is hardly a subject connected with the development and use of power which is not touched upon; the available resources of the various countries are reviewed in almost every instance, and a vast amount of statistical information will thus be brought together. Amongst the titles which catch the eye are those of papers on the utilisation of wind-power in Denmark, the electrification of railways, the utilisation of peat, pulverised fuel, the gas turbine, high-voltage d.c. generation and distribution (the "Transverter"), electro-farming, the electric propulsion of ships, alcohol as a source of power, large internal-combustion engines, steam at extra-high pressures, electrochemistry—a truly bewildering array, the publication of which will mark an era in the history of the electrical industry.

The provisional time-table shows that there will be an official reception followed by a banquet on Monday, June 30th; next morning the Conference will commence, and will sit daily till Friday, July 4th. On Monday, July 7th, the sittings will be resumed, ending on Friday, July 11th. During the fortnight there will be luncheons organised by the British Engineering Standards Association, the Gas Interests, the Canadian Committee, the Institution of Electrical Engineers, and the British Empire Producers' Organisation, as well as a reception by the American Committee. The Kelvin Centenary Celebrations will take place in the afternoon of Thursday, July 10th; the Kelvin medal will be presented to Prof. Elihu Thomson, and addresses will be presented by delegates from the bodies represented on the Committee of Honour, after which Sir J. J. Thomson will deliver the Memorial Oration. In the evening there will be a reception by the President of the Royal Society, and on Friday, July 11th, the Kelvin Centenary Banquet will take place.

On Saturday, July 12th, electrical engineering delegates, under the auspices of the Institution of Electrical Engineers, will pay a visit to Cambridge, and arrangements will be made jointly by the Institutions for reserved seats at Westminster Abbey and St. Paul's Cathedral on Sunday, July 13th, with a visit to the Zoological Gardens in the afternoon. The French, Italian, and Swiss official tours commence on the following day, but a trip to Birmingham has been organised by the I.E.E., including visits to the University, Nechells power station and Stratford-on-Avon. On Tuesday, the British and Scandinavian official tours begin, but again a programme has been arranged by the I.E.E., including a visit to the Underground Railways, and a drive to Windsor, with a conversazione organised by the three leading institutions in the evening.

Particulars of the official tours have also been issued. The British tour will embrace Manchester, the Lakes, Glasgow, Oban, Edinburgh, Newcastle, York, and Sheffield, and will last from Tuesday, July 15th, to Saturday, July 26th. The French-Swiss-Italian tour will extend through Northern France and Paris to Lyons, Geneva, Berne, Interlaken, Lucerne, Milan, Venice, and Domodossola, lasting from July 14th to August 4th; and the Scandinavian tour will include visits to Bergen, Tyssedal, Notodden, Rjukan, Christiania, Vamma, Trollhättan, Västeras, Alfkarleby, Stockholm, Malmö, and Hamburg, lasting from July 15th to July 30th. A second itinerary from July 28th provides for visits to Porjus and Kiruna, in Lapland, ending in London on August 5th.

It will be seen that a magnificent programme has been arranged, which alone will render the year a memorable one for those who are fortunate enough to take part in it.

Faraday House Old Students' Association.—The Association held its annual smoking concert at the Hotel Cecil on May 2nd. There was a very good attendance of past and present Faradians. The chair was occupied by the president of the Association, Mr. R. N. Vyvyan, M.I.E.E., and an excellent musical programme was provided, which included the following artistes: Miss Doris Ashton, Miss Gwen Lewis, Mr. Ronald Gourley, Mr. Lyell Johnston, Major Montgomery, and Mr. Colin Wark.

Legal.

Lee v. Hickmott.

ON May 7th this action was mentioned to Mr. Justice Branson, Mr. Compston asking that judgment should be entered for the defendant with costs on the action as originally brought, on which the findings of the jury were in his favour, and on the allegation of libel uttered to Mr. Temple, on which there was no evidence to go to the jury.

Sir HENRY MADDOCKS, for the plaintiff, contended that there could not be judgment on part of the issues referred to the jury. The jury were to deliver one verdict on all the issues. The issues were not so separate that they could be regarded as two actions. On the question of malice, the two parts of the case were interdependent. There was no precedent for a judgment on findings where the jury was discharged.

His LORDSHIP: They were not asked to return a general verdict.

Sir HENRY insisted that what he must set down for new trial must be the whole action, not an amended plea, that part had been disposed of by a verdict.

His LORDSHIP: What you need to prove if you must fight it out to the bitter end is that the statement complained of was made to Mr. Beadell. Do you suggest another jury may be asked to give different answers from those which this jury has returned?

Sir HENRY: The jury has not found against me on all the issues.

His LORDSHIP: Well, it seems to me a lamentable thing.

Sir HENRY: I can set down my action to-morrow for trial again, and I have no power to alter my pleadings.

His LORDSHIP: The whole of the action, as set down for 11 months, has been decided against you.

Mr. JUSTICE BRANSON said he thought the defendant was entitled to the judgment for which he asked. It was only on amendment, by leave of the Master in October last, that plaintiff added the two further complaints of slander uttered to Mr. Temple and Mr. Beadell, as to the first of which there was no evidence to go to the jury. Upon the other the jury disagreed. All other issues they found in defendant's favour. He accepted their answers, and the proper order as to costs was judgment for the defendant on those issues on which the jury had found in his favour and on the issue on which no evidence was forthcoming, leaving the other issue to be tried by another jury if the plaintiff thought fit, and that was the order of the Court.

Sir HENRY asked for a stay if plaintiff set down his action for new trial within a fortnight.

His LORDSHIP said he did not think this was a case for a stay.

Sir HENRY asked for a stay with a view to an appeal.

His LORDSHIP replied that if notice of appeal was given in a fortnight he would grant a stay on the defendant's solicitors undertaking to return the costs if the appeal went the other way, but if either party was to hold the money it must be the defendant.

British Thomson-Houston Co. Litigation.

THREE motions for judgment in default of either defence or appearance in actions by the British Thomson-Houston Co., Ltd., against Rennel, George and Jobling, and Leff came before Mr. Justice Tomlin on May 6th. It was stated that the actions were for injunctions restraining infringement of the plaintiffs' drawn wire patents.

His Lordship entered judgment in the usual form.

Motions by the British Thomson-Houston Co., Ltd., for injunctions restraining T. W. Crawford from infringing their patents for gasfilled electric lamps, and the Griffin Wireless Supplies Co., Ltd., from passing off as the plaintiffs' goods not of their manufacture, were before Mr. Justice Tomlin in the Chancery Division on May 9th.

There was no opposition, and his Lordship granted the injunctions asked for.

Fraudulent Use of Electricity.

ON May 1st, Charles Watson, timber merchant, was summoned by the Bury St. Edmund's Corporation for having fraudulently taken electricity from its mains.

The Borough Electrical Engineer (Mr. E. S. DAY) stated that defendant was in receipt of a power supply at the appropriate rate, but it was discovered that he was using this energy for lighting purposes. The solicitor who appeared for the defendant said that the latter was willing to pay for the electricity used; defendant was a very good customer of the Corporation.

The Bench imposed a fine of £25, including costs.

"Long Firm Frauds."

BEFORE the Common Serjeant (Sir H. F. Dickens, K.C.), at the Central Criminal Court, on May 5th, the hearing was commenced of the case against NATHAN NOVODVORSKY, 20, merchant, MORRIS ROSS, 28, merchant, and JOSEPH LEVENE, 23, salesman, who all pleaded not guilty to an indictment which charged them with conspiring together to cheat and defraud such persons as were induced to part with goods to

them upon the false pretence that they were carrying on a genuine business in the City under the style of the Butler Street Warehouse Co., Ltd. Ross also pleaded "not guilty" to offences under the Bankruptcy Act, and Novodvorsky pleaded "not guilty" to the falsification of books.

Mr. Percival Clarke and Mr. H. D. Roome appeared for the prosecution. Levene was represented by Mr. Walter Frampton, Ross by Mr. Malcolm Carter, and Novodvorsky by Mrs. Helene Normanton.

Mr. CLARKE, opening the case for the prosecution, said that the three defendants had conspired together to defraud people who might be induced to supply them with goods on credit by falsely representing that they were carrying on an honest and genuine business as the Butler Street Warehouse Co., Ltd. The Butler Street business having been started in February, a company was then registered as the Butler Street Warehouse Co., Ltd., with a capital of £1,000 in £1 shares, the directors being Nathan and Alfred Ellman. Mr. Clarke said that the company lived for just over five months, when it was wound up by order of the Court on November 27th of last year. Nine counts of the indictment were in respect of goods obtained on credit which were never paid for. Mr. Clarke said whether it was wireless accessories, electrical goods or hardware, it did not matter to the defendants so long as they did not have to pay for them. The jury found all the defendants guilty.

The JUDGE, addressing Novodvorsky, said that the only thing in his favour was his youth. When these frauds took place he was only nineteen, and he always liked to be lenient as far as possible with young men. The Judge added that the last time Novodvorsky came before him he was given a light sentence. It had done him no good, and these very clever frauds had been committed. He was a weak character, but certainly a very clever one. Having regard to his age he sentenced him to six months' imprisonment with hard labour. Addressing Ross, the Judge said he was satisfied he was at the bottom of these frauds, which had been very prevalent during the last year or two. He must go to prison with hard labour for twelve months. Levene was sentenced to nine months' imprisonment with hard labour.

Heavy Engineering Publications of the G.E.C.—We have received from the General Electric Co., Ltd., London, a set of publications relating to the "heavy engineering" products of its various factories which calls for more than passing comment. The set comprises two volumes of over 100 pages each, two of more than 60 pages, and three smaller brochures. The largest is entitled "Heavy Electrical and Mechanical Plant" (Bulletin No. 1, 1924), and consists almost wholly of excellent illustrations (91 in number) of the plant constructed at the Witton works of the G.E.C. and the Erith works of the Fraser & Chalmers branch of the company, including numerous turbo-alternators, direct-coupled and geared, a.c. and d.c. generators, turbo-blowers, rotary and motor converters and motor-generators, steam and electric winding engines, colliery and steel-works motors, textile motors, conveyors and transporters, and switchgear for all purposes.

Next is Bulletin No. 13, 1924, on "Turbo Plant," showing the Fraser & Chalmers turbines of various types in section, with numerous detail illustrations of the working parts; high, low, mixed, and back pressure turbines are included, as well as geared turbines and turbo-compressors. A large section deals with the electrical generators in almost equal detail, many views being given of machines in course of construction in the Witton workshops. This volume contains a large amount of letterpress relating to the various items, and the G.E.C. biased system of protection (McColl's patents) is described.

Bulletin No. 17, 1924, "Steam and Electric Winding Engines," also consists largely of text, explaining the conditions under which these machines have to work and the types in common use, as well as the methods of control and safety devices. Messrs. Fraser & Chalmers have had an experience of 40 years in this branch of engineering, and have done much pioneering work. Mining engineers especially will find this bulletin interesting, but the electrical features of the plant, which are very fully discussed, and include various methods of control, will interest wider circles. The volume is very freely illustrated with half-tones and working drawings.

Bulletin No. 19, 1924, relates to Fraser & Chalmers "Concentration Machinery," and appeals to specialists in this class of work. The three brochures—P(3) section, d.c. motors; P(4) section, a.c. motors, induction type; and P(6) section, transformers, are new editions of sections of the G.E.C. catalogue, and relate to the "Witton" manufactures; they are well illustrated and give full particulars of motors and transformers ranging from very small to the largest industrial sizes. The lists are not priced.

These publications have been prepared primarily for the British Empire Exhibition, but can be obtained by any engineer on application to the company; they bear convincing testimony to the vast manufacturing resources of the G.E.C., and are of value—especially the Bulletins—as true technical literature, which reflects great credit on the publicity organisation of the company.

Correspondence.

Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The "Transverter."

It is, I am sure, with the greatest interest that a large number of the members of the electrical profession will have perused the description relating to Messrs. Highfield and Calverley's transverter which appeared in last week's technical Press, and the encomiums which have been bestowed upon the inventors are thoroughly well deserved, for it is clear that the machine must have involved the solution of a tremendous number of new problems and difficulties which at first sight appeared almost insuperable. It must be very gratifying also to the inventors to have been able to obtain such a high overall efficiency as they have done.

While, however, I am prepared to grant that the transverter supplies an invaluable means for the transmission of comparatively small powers over extremely long distances, I think we must be careful not to be led away into believing that it will compete seriously with static step-up and step-down alternating current transformers for the transmission of power over moderate distances in large bulk.

I note that Mr. Roger Smith, in his references to the machine a year and a half ago, did not go beyond suggesting that the 2,000-kW size would be a standard size for railway transmissions, and he spoke of a transmission of 25,000 kW over a distance of 50 miles. Taking this as our basis, we would therefore require a "fleet" of 13 2,000-kW transverters at the generating station and, say, three at each of the substations for such a transmission.

Efficiency.—The first thing that strikes one is that the transverter introduces a gratuitous extra loss of 3 per cent. at the sending end, or say 6 per cent. at the sending and receiving ends combined, over that of large static transformers. Now in the paper which the writer read before the Institution of Electrical Engineers, he showed that even a 1 per cent. loss on a 25,000-kW transmission would be worth a sum of, roughly, £39,000 when capitalised; consequently the above 6 per cent. loss represents a sum of £234,000.

Attendance.—The next point that strikes one is that the cost of attendance for all these 26 machines, 260 commutators and 468 small single-phase transformers, each transformer having 10 windings differing in pressure by 100,000 volts from one another, will be very serious; also that the breakdown of any one of these 4,680 windings will put a transverter out of action. To attend properly to all these commutators and transformers will require a staff quite comparable with that employed in rotary converter substations, and a standing charge of some 10s. per kW per annum will be necessary in the substations at least, and a further sum of 5s. per kW per annum for the generating station. A total annual sum of some £18,000 per annum would therefore have to be paid in wages. This, capitalised at 5 per cent., represents £360,000.

Extra Capital Cost.—The next item that strikes one is that as the capital cost of the transverter is probably of the order of £5 per kW, there will be an expenditure of some £4 1s. per kW in excess of what there would be if large static transformers were used (to say nothing of the great increase in the floor space required in the generating stations and substations). Now 25,000 kW at £4½ per kW represents £112,500 extra capital outlay; which must be doubled, because they are required at the receiving end also, giving a total of £225,000 extra capital outlay.

Maintenance.—A fourth item, and one which must not be overlooked, is the extra cost of maintenance of 468 transformers and 260 commutators. If we take 10 per cent. per annum on £225,000, we get £22,500 per annum, which, capitalised at 5 per cent., is £450,000.

Summation of Charges.—Adding together, therefore, the above capitalised sums, which are debitable to the use of the transverter as against the use of plain a.c. static transformers, we have the following:—£234,000, £360,000, £225,000, £450,000 = £1,269,000.

This represents then (neglecting for the moment the extra dielectric losses) the sum which could be spent upon the cables for the transmission of the above power. I do not think that our cable companies will object to provide the necessary cables for a sum considerably less than half of this.

General.—It seems to me that the transverter has a very great field, and one that is exclusively its own, in the interlinking of generating stations whose frequencies differ, as well as the transmission of comparatively small amounts of power over very great distances on railway work—though in the latter case there may be two opinions as to the extent to which this can economically be done—but I shall not be sorry that, until something can be invented which has an efficiency equal to the static transformer (on a big scale), and which requires no more attention, and, further, whose capital outlay is no greater than the latter, we have yet reached the ideal—it may be that we shall never reach it, but, in any case, Messrs. Highfield and Calverley are to be congratulated on the great step in advance which they have made.

I ought not to close this letter, however, without saying that I have serious misgivings as to the advisability of having transformers, which may have to be lifted out of their case

in an open engine room, with all the drippings of oil and ...ess which this involves. It is the experience of those who ...re operating transformers at 33,000 volts in super-stations ...hat they are very glad to have them in brick cubicles with ...reproof doors; and the thought of 234 single-phase trans...formers at 100,000 volts in an open engine room is, to say ...he least, rather a startling proposition. I appreciate that, ...n account of the immense number of connections, it is ...lmost impossible to separate the transformers from the ...otating machine.

A. M. Taylor,
Major, S.O.2.

Erdington, *May 12th*, 1924.

The a.c. Commutator Motor and the Engineer's Education.

With reference to the letter in the ELECTRICAL REVIEW of April 25th, by your correspondent, Mr. Pensabene-Perez, in which he complains of the lack of interest and tuition in the matter of single-phase commutator motors, I would reply that he appears to have been unfortunate in his acquaintanceship with technical teachers and technical institutions. For many years now this important subject has been included in our advanced courses on alternating-current machinery and in the course on electric traction. Apart from the above lectures the students obtain practical instruction and carry out tests themselves on two of these machines forming part of the laboratory equipment.

W. H. Date,
LECTURER IN ELECTRICAL TECHNOLOGY.

The Polytechnic, London.
May 6th, 1924.

I am pleased to see Mr. T. Ellis's and Mr. Winfred's letters in your issue of the 9th inst. confirming my contention with regard to the lack of education on the subject of a.c. commutator motors.

I agree with Mr. Ellis that there are no publications dealing with these motors from a physical point of view. The reason of this is to be found in the fact that it is easier to deal with vectors and equations than to view the phenomena in their physical bearings. Vectors and equations are mechanical instruments by means of which we get the answer without taxing our brains unduly. This, as Mr. Ellis suggests, is not the only neglected subject.

Many writers of books either do not understand the phenomena they profess to explain or else do not understand the perplexities of a beginner. There is a plethora of the former writers, and they are a real danger to young inquiring minds.

Mr. Ellis is kind enough to suggest that I should write a series of articles on a.c. commutator motors, viewing the phenomena on their physical bearings only. A specialist without his tools of vectors, equations, &c., loses half his strength; he is handicapped by conventional conceptions which have no reality for the less specialised engineers. Still, if Mr. Ellis will help to draw the picture in the style he likes, of the private affairs of an a.c. commutator motor, what I know of them and my spare time will be at his disposal.

N. Pensabene-Perez.

London, *May 11th*, 1924.

The Single-phase Induction Motor and the Starting Problem.

I regret to note from Messrs. Pooley and Austin's letter of the 23rd ultimo that my letter, which appeared in your issue of the 18th ultimo, is capable of misinterpretation, as I, of course, did not wish to convey the impression that the Electro-Dynamic Construction Co., Ltd., claimed the sole merit of developing a single-phase commutator motor on commercial lines. I fully appreciate the contribution of Mr. F. Creedy towards the perfection of this type of machine.

However, I would respectfully point out to Messrs. Pooley and Austin that the 1906 patent to which they allude cannot be the master patent under which these motors have been made since 1906 by Messrs. Parkinson, as the patent in question refers only to variable-speed motors, a type which as far as I can ascertain, is not marketed by the above firm.

The only variable-speed commutator motor made in England as far as I know, by the Electro-Dynamic Construction Co., Ltd., is not the outcome of the lapse of the patent referred to above, as Messrs. Pooley and Austin suggest, but the result of theoretical and experimental research covering a period of several years at the E.D.C.C.'s works.

I am not very conversant with the machines with which Messrs. Pooley and Austin are associated but, from what information I can glean from their catalogue, they appear to differ very considerably in material points from the machine made by the Electro-Dynamic Construction Co., Ltd.

E. J. Timberlake,
THE ELECTRO-DYNAMIC CONSTRUCTION CO., LTD.

London, *May 6th*, 1924.

Referring to Mr. Rogers's letter in your issue of the 2nd inst., I begin to lose any hope of convincing him that the single-phase commutator motors made by the Electro-Dynamic Construction Co., Ltd., have a power factor of unity at full load and a leading current at fractional loads.

I have already given Mr. Rogers the results of a single test as follows:—

A 3-b.h.p., 210-volt, 83-cycle motor when driving a dynamo light took 5 amperes from the main. This I maintained was a leading current.

In fact, by running in parallel with it an ordinary single-phase induction motor running light and taking 4 amperes (lagging), the supply current feeding both motors remained approximately at 5 amperes.

Of course all this can be more easily seen by using a power-factor meter, but I should have thought that the above test would have appealed to Mr. Rogers who, as a station engineer, does not wish to increase the wattless load on his main when adding new motors.

As to the experience of installation engineers *re* commutator motors to which Mr. Rogers refers in his concluding remarks, I and my friends at the works have tried to understand the meaning and moral of the little scene described, but we had to give it up.

We can only say that the scene he describes has impressed us by its decided air of tragedy, but who among the actors (the gnat's leg, the rectifiers, the single-phase motor, the reciprocators, and the circulating water) is the villain of the piece we could not guess.

N. Pensabene Perez.

London, *May 5th*, 1924.

Pulverised Coal.

I read with interest the account of the reading of Mr. Jockel's paper "Water-tube Boilers" before the Junior Institution of Engineers in your issue of April 25th. There seems to be great prejudice in England against the use of pulverised coal despite the fact that the practice is firmly established in other lands and that greatly increased efficiencies are being obtained by this means.

In America and Canada during 1922 fifteen million tons were pulverised, whilst the figures for 1923 were about 17½ million tons—this shows that it is not only a well-established practice but also that it is fast becoming universal. In practically all new large construction, pulverising equipment is being installed. A glance through efficiencies obtained gives the reason.

It is also interesting to compare the boiler efficiencies obtained in England and various other countries. Mr. D. Brownlie, in tests on 400 boiler plants in over 50 industries in Great Britain, puts the average boiler efficiency at 58 per cent. Thus in Great Britain, burning 90,000,000 tons of coal per annum for steam generation, about 20,000,000 tons per annum is wasted through inefficient and out of date methods of combustion.

Another interesting point is the water screening of the furnace. This is practically a very modern innovation, but the results of a test at the Hell Gate station certainly are encouraging. This test boiler has side walls practically free from brickwork above the fire level. These walls are constructed of vertical tubes with fins welded on to fill the spaces between. The efficiency obtained at 181 per cent. of rating was 84.6 per cent. (without economiser). Including economiser, the efficiency reached 92.7 per cent. In a capacity test 528 per cent. of rating was maintained for three-quarters of an hour. It certainly seems that water screens are an advantage. The efficient utilisation of nature's resources is charged with public interest, and it appears that there is plenty of scope for improvement.

Jas. F. Edgell.

Maldon, *May 5th*, 1924.

The Electrical Equipment of Motor Vehicles.—The Union Automobiliste de France has recently been inquiring into the question of the causes of breakdowns of motor vehicles and has drawn up a table showing that they arise from eighteen main causes. The interest of the electrical engineer in the subject arises from the fact that unfortunately electrical derangements figure as the most frequent cause of breakdown, ignition being responsible for 9 per cent., engine-starting gear for 10 per cent., and electric lighting sets for 16 per cent.—a total of 35 per cent., as against only 65 per cent. for the remaining fifteen causes, of which accidents account for 10 per cent. The Union remarks that the electrical equipment of motor vehicles has not yet reached a stage of complete reliability, or it is not properly looked after by users, who are often entirely ignorant of electrical matters. It adds that "there would appear to be room for improvement in the protection of batteries and in the method of making connections so that they shall not be affected by jolting on bad roads. The number of ignition troubles proves that the perfect sparking plug has yet to be discovered and that the magneto, in spite of the greater experience of makers, is still liable to prove faulty in its operation."

Although it will generally be held in electrical circles that any trouble experienced with modern electrical equipment for motor vehicles is due more to the user himself than to the apparatus provided, it is obvious that in the design and manufacture of equipment, makers, for their own reputation, must take this factor into consideration and permit no slackening to occur in their efforts to produce equipment that shall be trouble-free.

Business Notes.

Bankruptcy Proceedings.—C. J. TOMLIN, electrical engineer, 12 and 13, Henrietta Street, Covent Garden, W.C.—Receiving order made May 1st, on creditor's petition. First meeting, May 15th. Public examination, May 27th, both at Carey Street, W.C.

C. R. A. CHADFIELD, electrical engineer, 12, Nottingham Street, Melton Mowbray.—Trustee, Mr. E. Barlow, official receiver, 1, Berridge Street, Leicester, released April 10th.

E. G. ROWE (Davies & Rowe), electrical engineer, 119, Dunraven Street, Tonypandy, Glam.—Trustee, Mr. E. Owen, official receiver, 34, Park Place, Cardiff, released April 4th.

H. BOOCOCK (Hardwick & Co.), electrician, 28, New Lane, Selby.—Last day for proofs for dividend, May 22nd. Trustee, Mr. H. C. Bowling, 24, Bond Street, Leeds.

W. E. WEEKS, wholesale electrical dealer, 59, Victoria Street, and 12, Felton Avenue, Horfield, Bristol.—Supplemental dividend of 1¼d. in the £, payable May 19th, at 18, Nicholas Street, Bristol.

E. W. J. WHITELOCK, electrical engineer, 4, Leagrave Road, and 7, Cheapside, Luton.—First and final dividend of 9s. 1¼d. in the £, payable at the office of Messrs. Keens, Shay, Keens and Co., 11, George Street West, Luton.

N. WILLIAMS, M. WILLIAMS, and W. COOK (British Radiophone Co.), makers of wireless apparatus, Downing Street, Bulwell, Nottingham.—First and final dividend of 8d. in the £, payable May 19th, at the Official Receiver's offices, 4, Castle Place, Nottingham.

P. M. HEALY (Associated Electric Co.), electrical factors, 21, Waterloo Street, Glasgow.—Public examination was to be held at 50, Wilson Street, Glasgow, May 12th; meeting of creditors May 21st, at the offices of Messrs. Maclean, Gardner and Aiton, 115, St. Vincent Street, Glasgow.

L. KELSALL AND H. KELSALL (Kelsall Bros.), electrical engineers, Castle Hill Place, Maison Dieu Road, Dover.—Receiving order made May 7th, on debtor's own petition.

L. L. JAMES (W. G. James & Son), electrical engineer, 62, Canterbury Street, Gillingham, and 137, High Street, Rochester, Kent.—Receiving order made May 6th, on debtor's own petition.

G. E. HARRIS, plumber and electrical engineer, 14, North Street, Emsworth, Hants.—Last day for proofs for dividend, June 2nd. Trustee, Mr. H. B. Morris, 20, Pearl Buildings, Portsmouth.

Company Liquidations.—SPRINGFIELD ELECTRIC MOTORS, LTD.—A petition for the winding up of this company, subject to the supervision of the County Court of Yorkshire, held at Leeds, was presented to that Court by Mr. V. Walton, chartered accountant, 26 and 27, Bond Street, Leeds, and was to be heard there on May 14th.

SWANAGE ELECTRICITY SUPPLY CO., LTD.—Winding up voluntarily. Liquidator, Mr. W. Topley, 2, Abbey Gardens, Westminster, S.W. Meeting of creditors May 19th, at the office of the Liquidator.

KEIGHLEY GAS & OIL ENGINE CO., LTD.—Winding up voluntarily. Liquidators, Messrs. W. Benson and R. A. Hargreaves, 30, Canal Road, Bradford. Meeting of creditors, May 16th, at the Midland Hotel, Bradford.

LIGHT-O'-DAY ELECTRIC LAMP CO., LTD.—Winding up voluntarily. Liquidator, Mr. C. S. Steel, 34-36, Gresham Street, E.C. Meeting of creditors was called for May 14th, at the offices of Messrs. Wright, Fairbrother & Steel, 34 & 36, Gresham Street, E.C.

GLEVUM MOTOR & RADIO CO., LTD.—Winding up voluntarily. Liquidator, Mr. H. G. Kingscott, Eastgate House, Gloucester. Meeting of creditors at Liquidator's offices May 20th.

AQUA ELECTRIC CO., LTD.—A meeting of members is called for June 12th, at 316, Abbey House, Victoria Street, S.W., to hear an account of the winding-up from the Liquidator, Mr. R. Manners.

Private Arrangements.—CHARLES MALCOLM FARQUHAR, manufacturer of telephone and wireless apparatus, trading as the Dynaphone Works, Ridsdale Road, Anerley, London, S.E.—The creditors interested herein were called together recently, when a statement of affairs was presented which showed liabilities of £1,958, made up as follows: Trade creditors, £1,011; expense creditors, £123; cash claims, £469; and bank overdraft, £355. The assets were £885, leaving a deficiency of £1,073. The statement showed that the debtor possessed patents which cost him £242, but no value was placed upon them at the moment.

It was reported that the debtor commenced business in April, 1923, with a capital of £1,072. His sales had amounted to £3,231, with a gross profit of £228, while there was a net loss of £569. In addition, the drawings were £352. It appeared that the debtor bought certain patents for a telephone and entered into a contract for a well-known radio company to take all his output. Under the contract he estimated that he would make a profit of 20 per cent., and he began delivery in August, 1923. Unfortunately, something went wrong with the 'phones, and some hundreds of them were returned. The difficulty was thought to have been surmounted, but subsequently the same trouble reappeared. Originally the contract price was 10s. 6d. a pair, which was subsequently reduced to 7s. 6d. a pair. Altogether the debtor seemed to have disposed of 8,560 pairs of 'phones, but rather more than 2,000 were returned, and expense was incurred in putting them right. No definite offer was submitted, and it was decided that a deed of assignment should be executed in favour of Mr. G. G. Poppleton, C.A., of Messrs. Poppleton, Appleby and Hawkins, 4, Charterhouse Square, E.C., and Mr. L. Millar, C.A., of 10, Coleman Street, E.C., as joint trustees. A committee of three of the principal creditors was also appointed.

Dissolutions of Partnership.—PICKARD & Co., wholesale electrical engineers, 7, Bedford Circus, Exeter.—Mr. F. Pickard and Mr. A. F. Lord have dissolved partnership. Mr. F. C. Pickard is carrying on at 7, Bedford Circus, Exeter on behalf of a group of wholesale companies.

WOOD & BRAMWELL, electrical engineers, 234, Fulwood Road, Sheffield.—Mr. W. Wood and Mr. J. Bramwell have dissolved partnership. Mr. Wood will attend to debts and continue the business.

Deed of Arrangement.—MRS. M. B. HAMILTON (Vu-Dry Battery Co.), 56, Marlborough Road, Holloway, N.—Particulars of claims by May 31st to the Trustee, Mr. A. Hillyer, 2, Broad Street Place, E.C.

Deed of Assignment.—J. LEITCH (Marylebone Electric Fittings Co.), electrical fittings manufacturers, 4, Ramillies Place, Oxford Circus, W.—Particulars of claims to the Trustee, Mr. W. A. J. Osborne, 119, Finsbury Pavement, E.C., by May 21st.

Catalogues and Lists.—METROPOLITAN-VICKERS ELECTRICAL Co., LTD., Trafford Park, Manchester.—Supply List No. 140/15, containing prices and particulars of a large variety of "Cosmos" fans. Also an attractive folder advertising these fans.

THE LONDON FACTORS & AGENTS, LTD., 38 & 39, Parliament Street, S.W.1.—A price list of electrical accessories and materials, including radio apparatus.

MESSRS. L. G. HAWKINS & Co., LTD., 116, Charing Cross Road, W.C.2.—An illustrated folder describing a "Universal" electric cooker, of new design.

MESSRS. J. E. HOUGH, LTD., Edison Bell Works, Glenarm Road, S.E.15.—An illustrated catalogue of radio receiving sets and components.

MARCONI'S WIRELESS TELEGRAPH CO., LTD., Marconi House, Strand, W.C.2.—Sheet 25a, illustrating a "Type B.P." portable receiving set; Leaflet No. 1,022, describing the Marconi magnetic drum recorder; Leaflet No. 1,024, "Wireless for Police Work"; Pamphlet No. 226, treating of radio apparatus for aircraft; and Pamphlet No. 229, describing low oscillation generators.

THE ELECTRICAL SUPPLIES Co., LTD., 233, Tottenham Court Road, W.1.—May price list of electrical materials and accessories.

THE EDISON SWAN ELECTRIC Co., LTD., 123-5, Queen Victoria Street, E.C.4.—A fully-illustrated catalogue of electric lamps of many designs. Priced.

THE CHLORIDE ELECTRICAL STORAGE Co., LTD., Clifton Junction, Manchester, has issued Exide battery service technical letter No. 5 for motor-car dealers, dealing with the subject of wiring and connections.

THE SIMPLEX ELECTRIC Co., 45, Harrow Road, Brislington, Bristol.—A pamphlet advertising the "Andy" fuse wire.

MESSRS. SULZER BROS., 31, Bedford Square, W.C.1.—An illustrated booklet describing "Sulzer" two-cycle Diesel engines with airless injection.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 28, Victoria Street, S.W.1.—May stock list of motors and dynamos.

MESSRS. F. W. BERK & Co., LTD., 1, Fenchurch Avenue, E.C.3.—A small showcard advertising sulphuric acid for accumulators.

DRAKE & GORHAM WHOLESALE, LTD., 67, Long Acre, W.C.—Pamphlet No. 399, illustrating a number of electric fans. Priced.

MESSRS. SIEMENS BROS. & Co., LTD., Woolwich, S.E.18.—Catalogue No. 595, containing descriptions of the company's radio receiving sets and accessories. Fully illustrated and priced.

BRITISH INSULATED & HELSBY CABLES, LTD., Prescot, Lancs.—List No. P.186, containing particulars and prices of "Prescot" jointing materials and accessories—compound tapes, sleeves, cable thimbles, &c.

MESSRS. GAMBRELL BROS., LTD., Merton Road, Southfields, S.W.18.—An illustrated catalogue of electrical instruments for testing, &c., with price slips.

MESSRS. T. HARDING CHURTON & Co., LTD., Atlas Works, Water Lane, Leeds.—An illustrated booklet containing illustrations and specifications of a.c. induction motors.

THE BRITISH THOMSON-HOUSTON Co., LTD., Rugby.—Descriptive List No. 3,120, dealing with a.c. switchboards for 3-phase 3-wire insulated or earthed systems up to 11,000 V; Descriptive List No. 3,315, describing compound-filled truck-type switchgear for 3-phase systems up to 33,000 V; Price Supplement No. 5,031A—mining controllers and resistances; and

list No. 5,650—Section 3—d.c. automatic crane control equipment.

THE CABLE ACCESSORIES CO., LTD., Britannia Works, Tividale, Tipton, Staffs.—An illustrated and priced catalogue of electric fans, fixed and oscillating, of various patterns.

THE CAMBRIDGE & PAUL INSTRUMENT CO., LTD., 45, Grosvenor Place, S.W.1.—A mailing card advertising a catalogue of instruments for the power plant.

THE BURWOOD ELECTRICAL SUPPLIES CO. (1924), 41, Great Queen Street, W.C.2.—A sheet bearing illustrations and prices of radio receiving sets and components.

THE MACHINE TOOL TRADES ASSOCIATION, 70, Victoria Street, S.W.1, has issued, on behalf of its members, a very comprehensive catalogue (384 pp.) of British machine tools. It is priced at 10s. 6d., and is prefaced with a list of the Association's members, giving particulars of their products, agents, &c. The body of the publication is devoted to well-illustrated descriptions of each firm's manufactures. The catalogue constitutes an excellent guide to the industry, and it is of interest to learn that French and Spanish editions are in course of preparation.

Trade Announcements.—MESSRS. GREENLY'S, LTD., advertising agents, have removed to larger premises at 5, Chancery Lane, W.C.2, the building adjoining H.M. Record Office. Since the business was founded by Mr. Greenly nine years ago the staff has increased from two to 40 assistants.

The Board of Trade consent has been obtained for changing the name of the CAMBRIDGE & PAUL INSTRUMENT CO., LTD., to the CAMBRIDGE INSTRUMENT CO., LTD. The head office and showrooms will continue to be at 45, Grosvenor Place, S.W.1, and the business will be carried on exactly as in the past.

The business of MESSRS. BELLAMY, PRITCHARD & CO., electrical engineers, of High Street, Lye, will in future be carried on by Mr. Raymond Arthur Pritchard, under the style of A. PRITCHARD & CO.

THE CABLE ACCESSORIES CO., LTD., announces "substantial" reductions in the price of its "Baby" switchgear.

MESSRS. GEORGE ANDREWS & CO., electrical engineers, of Cumbergate, Peterborough, have opened a branch business in New Street, Boston.

A Window Display at Bradford.—Very simple means provided an excellent window display in the showrooms of the Bradford City Electricity Department recently, to encourage the sale of radiators. The principal figure was a pretty baby doll, with a winsome expression, seated on a towel and apparently in the act of giving itself a good scrub with a towel after getting out of a bath partially filled with water, shown on the right-hand side of the accompanying illustration. The suggestion of a bath-

A Window Display at Bradford.

room was very cleverly made by a screen, which formed the background, the lower portion being covered with paper to represent white tiles, while the upper portion represented marble with a bold panel design. One radiator was placed to give the appearance of being turned on to the doll, while others were placed about the floor. A window card bore the words: "You can do with one of these in your bathroom."

Proposed Indian Tariffs.—A list of articles upon which import duties are proposed by the Indian Tariff Board was published in the last issue of the *Board of Trade Journal*. The object of the Board was the protection of the Indian steel industry, and among the articles in the list are tramcars and component parts and accessories, and tramway track material. Upon these it is recommended that *ad valorem* duties of 15 and 10 per cent. respectively be imposed.

The Eight-hour Day in Belgium.—The Belgian Government has recently appointed a commission of 40 members to inquire into the working of the existing Eight-hour Day Act. In addition to representatives of Government Departments, manufacturers' and workmen's associations are included in the Commission.

Book Notices.—"Automatic Telephones," by F. A. Ellson. Pp. vi+210; 48 figs. London: Sir Isaac Pitman and Sons. Price 5s. net.

"Automatic Telephone Systems," by W. Aitken. Vol. III. Pp. xiv+339; figs. 147. London: Ernest Benn, Ltd. Price 55s. net.

"The Strength of Dished Ends," by C. C. Pounder. (52 pp., 70 figs.) New Malden: Vizetelly & Co. (for the Association of Engineering and Shipbuilding Draughtsmen). Price 2s.

Publications of the Massachusetts Institute of Technology, No. 37, "Transient Conditions in Electric Machinery," and No. 38, "Artificial Transmission Lines with distributed constants." Boston (Mass.): The Institute.

Recent Contracts.—THE GENERAL ELECTRIC CO., LTD., has received large lamp orders from the Admiralty, and also a six-months' contract for the supply of lamps to Dublin Union.

British Trade-mark Applications.—The following are among the recent applications for British trade marks. Objections to any of the proposed marks may be entered within one month from the dates mentioned. In the case of foreign applications the name and address of the British representatives are also given:—

Gallia. No. 437,936. Class 8.—Electrical apparatus for dressing, undulating, and curling the hair. Gaston Boudou, 400, Rue Saint Honoré, Paris. (Lloyd, Wise & Co., 10, New Court, Lincoln's Inn, London, W.C.2.) May 7th, 1924.

Clix. No. 441,477. Class 13.—A combined plug and socket for use in electrical work as a contact or terminal. Autoveyors, Ltd., 84, Victoria Street, Westminster, S.W.1. May 7th, 1924.

Audion. No. 444,947. Class 8.—Instruments for use in wireless telephony or telegraphy. George Turncock, 41, High Street, Aston, Birmingham. May 7th, 1924.

Wyray (lettering and design). No. 444,821. Class 8.—Instruments and apparatus for use in wireless telephony and telegraphy. Frank R. Hickson, trading as F. R. Hickson, 16, Dartmouth Park Hill, London, N.W.5. May 7th, 1924.

Australasian Factory Expansion.—The Commonwealth statistician's report states that during the past three years the factories in Australia have been expanding at a rate of 759 per annum, and that on an average 11,872 additional employés have been absorbed each year. The capital invested in factories in the year 1922-23 amounted to £160,513,629, compared with £113,017,165 in 1919. During the past year there were 19,169 factories, employing 415,349 workers, and the value of their output was £326,448,189.—*Daily Mail*.

Electricians' Wages.—At a special meeting of District Council (No. 2), Electricity Supply Industry (Yorkshire, &c.), on May 1st, the application by the employés for a general increase in wages of 10s. per week was considered. For the employers' side it was stated that, having regard to the recent award (February) and to the fact that the sliding-scale agreement had met the position since, no case had been made out by the trade union side. The employers, however, were willing to submit the matter to arbitration. The employés' side also agreed to arbitration if a majority of the district councils were in favour of this course and if the matter was considered nationally. To this the employers replied that, having regard to the level of the wages paid in the No. 2 area as compared with the wages paid in comparable industries in the area, they were prepared to abide by an award of a National Court dealing with the areas separately. The trade union side could not agree to this, and the Council adjourned without arriving at any agreement in the matter.

The *Daily Herald* states that the London employers have refused to concede the national demand for 10s. a week increase, and have offered arbitration instead. Nearly 1,000 members of the National Amalgamated Union of Enginemen, Firemen, Mechanics and Electrical Workers, meeting at Battersea recently, decided unanimously to reject the employers' proposal, and to press for a national "down-tools" policy. A similar resolution was passed at a Maida Vale meeting on May 6th, attended by 700 members of the same union.

Crewe Railway Works to be Electrified.—Referring to the paragraph bearing the above heading in our issue of April 25th (p. 655), the managing director of the North Wales Power Co., Ltd. (Mr. H. J. Jack) writes as follows:—"Crewe is in the area of the North Wales Power Co., and a contract is about to be concluded between the London, Midland and Scottish Railway Co. and the North Wales Power Co. for large supplies of energy to the railway works at Crewe. At present two new hydro-electric power stations, aggregating 27,000 kW. are under construction for supplies in the North Wales and South Cheshire Electricity District, as well as many miles of 33- and 66-kV transmission lines, but since the railway company requires a supply at Crewe at a very early date, the North Wales Power Co., by arrangement with the Mersey Power Co., is about to construct, at its own cost, approximately 25 miles of 33-kV double-circuit transmission lines between Runcorn and Crewe for temporary supply at the Crewe Railway Works, and for reciprocal supplies between the four hydro-electric stations, which will serve the North Wales Power Co.'s area, and the steam station of the Mersey Power Co. at Runcorn."

Paper-weight.—MESSRS. GOODBRAND & CO., LTD., Britannia Foundry, Stalybridge, have sent us a glass paper-weight, upon the base of which is a view of one of their economiser installations.

The Dutch Cable Works.—The report of the N. V. Nederlandsche Kabelfabriek states that the exports in 1923 increased, and better prices were frequently obtained abroad than in Holland, where foreign makers were in the market at very low prices. The gross profits are returned at 730,000 florins, and after having made provision for depreciation, the balance permits of the distribution of a rate of 15 per cent. on the ordinary share capital, which amounts to 2,500,000 florins.

Lead.—Reporting on the outlook, last week, Messrs. James Forster & Co. said:—"The price in America is rapidly falling in sympathy with the London market, and it is said that with consumption there at its present level it will be quite unable to take any Mexican lead. Consumption of lead in France is also falling off, certain parcels bought by consumers there being transhipped to the London market for resale, so that under present conditions this market seems bound to have to absorb the bulk of the Mexican lead during the next three months. Supplies of lead here are quite sufficient without any Mexican lead, and with arrivals of this brand expected before long there is every prospect of an excess of supply over demand. Of course, it must be remembered that this has already been discounted to a considerable extent by the heavy fall in values, but the actual arrival of the metal may have a further depressing effect; in any case, there seems little prospect of any temporary advance being sustained."

British Empire Exhibition Note.—Messrs. Johnson and Phillips, Ltd., have issued a little pocket book for the use of visitors to the Exhibition. It describes the firm's activities, and contains a diary for from April 30th to May 27th.

Football.—The football section of the General Electric Co., Ltd., dined at Pritchard's Restaurant, Oxford Street, on the 9th inst, Mr. L. C. Gamage presiding. Those present included Mr. H. Hirst, Mr. M. J. Railing, and Mr. J. Y. Fletcher, and also representatives of several of the teams who opposed the "Magnets" during the past season. The season was a very satisfactory one. Mr. H. Hirst responded to the toast of the G.E.C., which was proposed by Mr. H. W. Roberts. Presentations were made to Messrs. Hill, Chard, Knight, Strong, and H. Roberts.

New Companies in India.—Among the new undertakings recently formed in India in connection with the electrical and mechanical trades are the British Thomson-Houston Co. (India), 8, Clive Street, Calcutta, with a capital of 3,000,000 rupees; Thomas Dear & Co., Mercantile Buildings, Lall Bazaar, Calcutta, capital 100,000 rupees; and the Textile, Electrical and Allied Industries Co., 17, Ezra Street, Calcutta, capital 100,000 rupees.

Hart Accumulator Strike Settled.—As stated in our last issue, the recent strike which occurred at the works of the Hart Accumulator Co., Ltd., Stratford, has now been settled. The company says that the employés' demand was that they should be paid for statutory holidays and granted one week's holiday annually with pay. The company did not agree to this, and the men came out on strike on March 12th. The strike lasted seven weeks, but at the end of that time the men withdrew their demands and offered to resume work. The company had filled a number of the vacancies created by the dispute, but 160 of the old employés were re-engaged, and the remainder will be absorbed as soon as this is possible.

Dynamo-makers' Profit-sharing Scheme.—On May 3rd Messrs. Horace Green & Co., Ltd., dynamo and motor makers, Cononley, distributed their 12th annual dividend to employés, who celebrated the occasion by holding a social and dance. The profit-sharing scheme in operation is simply based on the wages paid ranking as capital. Since the introduction of the scheme an average dividend of 8 per cent. has been paid, and in the present year it amounts to 7½ per cent. This result is noteworthy considering the difficult trading conditions contended with.

Local Exhibition.—Greenock.—An exhibition of electrical appliances, arranged by the Corporation Electricity Department, was opened in the Town Hall on May 8th.

Lamp Manufacture in Belgium.—La Société de la Manufacture Belge de Lampes Electriques Mazda, in which the Société de l'Electricité et de Mécanique is largely interested, has recently considerably extended its works in Ghent, and, with the installation of the latest machinery, the undertaking hopes to secure a considerable share of the lamp trade in Belgium.

Our Foreign Trade—April Figures.—The following were the values of imports and exports of electrical goods and machinery during April, 1924:—

	April 1924	Inc. or	4 months, 1924. Inc. or dec.
Imports.—	£	£	£
Electrical goods and apparatus	226,329	+ 2,766	+ 201,827
Machinery	845,931	− 75,493	− 1,061
Exports.—			
Electrical goods and apparatus	891,580	+160,500	+ 450,054
Machinery	3,531,800	−187,084	−3,582,701
Re-exports.—			
Electrical goods and apparatus	9,431	+ 1,899	+ 19,680
Machinery	108,575	+ 4,367	+ 4,369

Sydney Contracts.—With further reference to this matter reports just to hand show that in March the Lord Mayor of Sydney was officially advised that the electrical contractors who, on their own admission, added a certain amount to their tenders for City Council contracts for the purpose of disbursement amongst the unsuccessful tenderers, had not committed any illegal act. The matter was before the City Council on March 11th on a report from the Electricity Supply Committee, which declined to recommend the acceptance of tenders amounting to nearly £90,000 from one of the firms concerned.

Arrangements were made on March 19th, according to the *Sydney Morning Herald*, for the purpose of extending the inquiry ordered by the City Council into the admissions made by five electrical firms. The first committee has been discharged, and the new committee is to consist of aldermen only, in accordance with the following resolution passed at the City Council after two hours' debate:—"That the special body appointed to investigate the matter be discharged, and that a special committee of aldermen be appointed to take its place, and that, in view of the admissions made by the contractors, the opinion of King's Counsel be obtained as to whether the Australian Industries Protection Act has been contravened."

The Canadian Electrical Industry.—In the course of a report upon commercial and industrial conditions in Canada which is published in the *Board of Trade Journal*, H.M. Trade Commissioner at Toronto states that during the past year the electrical equipment business generally showed an improvement over 1922, but was still much below normal. It is estimated that the various electrical companies in the Dominion were able to operate their plants at only 25 per cent of capacity. A Toronto director of the English Electrical Co. of Canada stated that the figures for 1923 will show a substantial increase over the previous year. Late bookings are the heaviest since the inception of the company, and include important contracts for traction, water power, and mining equipment. During the past few months a British manufacturer of switchgear has established small branch works in Ontario. An important British firm has also reorganised its Canadian works and organisation in Quebec Province. The report for 1923 of the Canadian Westinghouse Co., Hamilton, Ontario, states that during the first few months of the year an extraordinary demand for large capacity hydro-electric generating units developed. Among the company's bookings was the largest individual order for electric generators heretofore placed in any part of the world, the total capacity of this one order amounting to upwards of 300,000 h.p. At what might be termed the other end of the manufacturing scale the demand for radio apparatus has been large and increasing, while, between these, the broad field of supply to the multifold industrial uses of the country has been active in only an average degree. The influx of orders for large capacity units, taken in the light of the prospect for continued development in exploitation of the abundant water-power resources of Canada, indicated the desirability of providing appropriate additions to the plant for facilitating production in this line of work. Accordingly during the year some essential additions were made to the large machine tool equipment of the plant, and the construction of a new pattern shop and foundry with modern arrangements for the economical handling of large work were put under way by the company. A report compiled for the Ontario Government and tabled in the Legislature in March showed that nearly 150 million dollars has been invested in the enterprises of the Hydro-Electric Power Commission of Ontario. Extensions continue to be made.

Lighting and Power Notes.

Abergavenny.—Proposed Electricity Supply.—The Town Council has under consideration the question of providing an electricity supply for the town. It proposes either to obtain a bulk supply or to erect its own generating station.

Bingley.—Year's Working.—The accounts of the Council's electricity undertaking for the year ended March 31st last show a net profit of £2,008. This is the tenth year of the undertaking and the second time a net profit has been made. The revenue has increased from £1,700 in 1914 to £14,101, and the number of consumers from 42 in the first year to 588. The supply is obtained in bulk from Keighley Corporation on a ten years' agreement, which has been renewed for a similar period at a slightly higher price per kWh.

Blackburn.—Electricity in Bulk.—The Electricity Committee has received an inquiry from the Mid-Lancashire District Board, asking for the terms upon which the Corporation would supply electricity in bulk to Accrington.

Blackpool.—Loans.—The Town Council is applying to the Electricity Commissioners for sanction to borrow £8,200 for two 800-kW rotary converters required in connection with the tramway undertaking, and for £28,000 for future mains extensions, and to cover excess expenditure on a previous loan

Burnham.—ELECTRICITY SUPPLY.—The Slough and Datchet Electric Supply Co. has informed the Eton Rural District Council of its intention to extend the underground cables from Slough to Burnham, to give a supply of electricity to that district.

Burnley.—NEW PLANT.—As an unemployment relief scheme, the Corporation electrical engineer has introduced a proposal to increase the plant by a 1,000-kW converter, with switchgear, at a cost of £5,000. The proposal has been approved by the Electricity Committee, and application is to be made for a Government grant.

Continental.—BELGIUM.—Steps are being taken by a group of townships in West Flanders to set up an electricity supply network to serve the whole province. The promoters are seeking the financial assistance of a company which is about to supply 17 townships. The Provincial Council has already voted a credit towards the undertaking, and is in favour of the more comprehensive scheme.

GERMANY.—Three power stations are projected on the Upper Rhine to be constructed under the joint charge of the Swiss and Baden Ducal Governments. The stations will be situated at Rekingen, Dogern, and Schwörstadt, and will have a capacity of 32,000 h.p., 80,000 h.p., and 86,000 h.p. respectively.

PORTUGAL.—The Compagnie Réunie Gaz et Electricité de Lisbon is now supplying electricity to 37,080 consumers, an increase of about 19,000 during the past two years. An order has been placed for a new 8,000 kW turbo-alternator.

FRANCE.—Steady progress continues to be made by the Compagnie Centrale d'Energie Electrique, the output of the generating stations in Rouen having reached a total last year of 61,172,924 kWh, as against 53,082,420 kWh in 1922. A new 6,000-kW set is approaching completion at the Grand Quevilly station, for which also a third set of 10,000-kW capacity has been ordered. When this is in operation the station will have a total capacity of 60,000 kW. A new 1,000 kilowatt set has also recently been installed at the company's station at Chateauroux.

Dewsbury.—EXTENSION OF SUPPLY.—The Town Council has approved a scheme submitted by the electrical engineer for supplying electricity to the Bank Top district of Earlsheaton, at an estimated cost of £2,250, and application is being made to the Electricity Commissioners for sanction to the borrowing of this sum.

Ely.—ELECTRICITY SUPPLY.—A scheme for the supply of electricity to Ely and the adjoining district, prepared by Messrs. C. R. St. John and Partners, consulting engineers, has been submitted to the Urban District Council, which is now considering it.

Golborne.—ELECTRICITY SUPPLY.—The Urban District Council has decided to support the application of the Lancashire Electric Power Co. for an Order authorising it to supply electricity to the district for public and private purposes.

Grampian Electricity Supply Bill.—The Forfar County Council has withdrawn opposition to the Grampian electricity scheme. The promoters have undertaken to lay a cable to a point within six miles of the burgh of Forfar.

Horwich.—ELECTRICITY SUPPLY.—Orders for cables and electrical equipment have been placed by the Town Council in connection with the electricity scheme. Delivery of the electrical equipment is expected in about two months' time. A tentative scale of charges fixed by the Council places the price for lighting at 6d. per kWh.

India.—RAWALPINDI.—Sir Edward Maclagan laid the foundation stone on April 2nd of a power station for the Rawalpindi Electric Supply Co. It is hoped that a supply of electricity will be available by the end of the year.

Irish Free State.—CLONMEL (Co. TIPPERARY).—At a recent meeting of the Corporation the report of Mr. Martin, of Messrs. Turney, consulting electrical engineers, Dublin, on the proposed electricity scheme for the district was adopted.

Letchworth.—SPECIAL ORDER.—The First Garden City, Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to extend its area of electricity supply so as to include the urban district of Biggleswade and certain parishes in the rural district of Biggleswade.

Leyton.—LOANS.—The Urban District Council has received the sanction of the Electricity Commissioners to a loan of £5,000 for mains, and a further loan of £6,700 for feeder mains, &c., has been applied for.

London.—HAMPSTEAD.—The Borough Council has confirmed the recommendation submitted by the chief engineer and general manager of the electricity undertaking regarding charges for free wiring and electric cookers. The scale of charges is as follows:—Free wiring: Additional charge of 2d. per kWh on the current flat rate for lighting, the minimum consumption for from 4 to 8 points installed to be 20 kWh per quarter, and from 9 to 12 points, 30 kWh per quarter. Electric cookers: To be installed free of charge, including the necessary wiring up to an agreed value. Consumers to guarantee a minimum consumption of 400 kWh per quarter, for which a charge of 50s. will be made. The charge for any energy in excess of this amount will be 1½d. per kWh.

Manchester.—LOAN.—The Electricity Committee has recommended to the City Council that application be made to the Electricity Commissioners for sanction to the borrowing of £100,000 for the provision of feeder mains.

New Zealand.—GREY.—The ratepayers have approved a proposal to borrow £80,000 for a hydro-electric scheme to serve the whole district. It is proposed to utilise the Arnold River for this purpose. Work on the scheme will commence next June, and it is anticipated that it will be completed 18 months thereafter.

Nottingham.—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking (engineer: Mr. H. Talbot) for the year ended March 31st last show a total revenue of £305,099, as compared with £269,566 in the previous year. Working expenses amounted to £159,669, as against £152,109, leaving a gross profit of £145,430 (£117,459). After payment of capital charges there was a net profit of £85,133 (£61,936), of which £25,000 was contributed towards the relief of the rates and £60,133 placed to the reserve fund. The electrical energy sold amounted to 22,922,460 kWh, an increase of 2,520,934 kWh. The engineer states that a supply of electricity is now being given to a number of consumers in Old Basford and Bulwell, a h.p. main is being laid to Hucknall, and good progress is being made with the l.p. mains in West Bridgeford. At North Wilford power station the building is progressing favourably, and work on the erection of the boilers has commenced.

Northern Ireland.—COLERAINE (Co. LONDONDERRY).—At a meeting of the Urban District Council on May 5th, the Committee in charge of the proposed electricity scheme recommended that Mr. C. J. Leigh, of Liverpool, should be engaged to prepare a modified scheme and estimate for an electricity supply for the district.

CUSHENDALL (Co. DOWN).—At a recent meeting of the Ballycastle Rural District Council it was stated that the Ministry of Home Affairs was prepared to grant the Council an Order authorising it to supply electricity in Cushendall.

Plymouth.—SPECIAL ORDER.—The Corporation is applying to the Electricity Commissioners for a Special Order authorising it to extend its area of electricity supply so as to include the parish of Compton Gifford.

Price Reductions.—Reductions in the charges for electricity have been made in the following districts:—

GUILDFORD.—Lighting: First 500 kWh per quarter, 7½d. per kWh; beyond, 4½d. per kWh. Power and heating: First 500 kWh per quarter, 2½d. per kWh. All energy in excess of this amount, 2d. per kWh. The minimum charges are 10s. for the winter quarters and 5s. for the summer quarters.

BASINGSTOKE.—Scale A.—Private lighting: First 250 kWh per quarter, 7½d. per kWh; next 250 kWh, 7d.; all energy in excess of this quantity, 6½d. per kWh. Public buildings: First 250 kWh per quarter, 7d. per kWh; next 250 kWh, 6½d.; above this amount, 6d. per kWh. Outside lighting: Flat rate, 6½d. per kWh. Scale B.—Power, heating, and cooking: The rate varying from 3d. to 1½d. per kWh according to quantity consumed. Scale C.—Tariff for domestic purposes: Fixed charge of 15 per cent. per annum on the rateable value, plus 1½d. per kWh for electricity used for all purposes.

WINCHESTER.—Lighting: Flat rate, from 7½d. to 7½d. per kWh; maximum demand rate, from 9½d., 5½d., and 2½d. to 9d., 5d., and 2d. per kWh; prepayment meters, from 10½d. to 10d. per kWh.

SUTTON COLDFIELD.—Lighting: From 7½d. to 6½d. per kWh.

Redcar.—LOAN SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £11,000 for the completion of the electricity scheme.

Salford.—LOAN.—The Electricity Committee has recommended to the Town Council that application be made to the Electricity Commissioners for sanction to the borrowing of £2,380 for the erection of an additional sub-station at the junction of Weaste Road South and Hassle Street, Pendleton.

Skegness.—ELECTRICITY SUPPLY.—The Urban District Council, after considering the question of an electricity supply for the district, has appointed a deputation to interview the Electricity Commissioners before taking any definite steps in the matter. It is estimated that the cost of the Council's own scheme would be £44,000.

Slaithwaite.—LOAN.—The Urban District Council is applying for sanction to a loan in connection with its electricity scheme, the cost of which is estimated at £14,076.

South Africa.—LYDENBURG.—A loan has recently been raised for the provision of an electricity supply for the town. A waterfall 7½ miles from the town will be utilised. The estimated cost of the scheme is £16,456.

JOHANNESBURG.—The Electricity Commission has reported against the Municipal Council's scheme for a new power station, as it is of opinion that electricity can be obtained at less cost from the power station which is being erected at Witbank.

BULAWAYO.—A recent issue of the Southern Rhodesia Government *Gazette* contains the text of a Private Bill which the Bulawayo Municipal Council is to present to the Legislative Assembly of Southern Rhodesia, to enable the Council to raise a loan not exceeding £350,000 for the purpose of providing water and electricity supply and other public works.

Southwick.—Electricity Agreement.—The Urban District Council has sealed an agreement with the Brighton Corporation for a supply of electricity. The maximum charges will be 7d. per kWh for lighting and 2d. per kWh for power.

Sussex.—Special Order.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation a Special Order authorising the Sussex Electricity Supply Co., Ltd., to supply electricity in parts of the rural districts of Horsham, Cuckfield, and East Grinstead, in the county of Sussex, and part of the rural district of Reigate, in the county of Surrey.

Stafford.—Year's Working.—The accounts of the electricity undertaking for the year ended March 31st last show a total income of £30,198, as compared with £26,435 in the previous year. Working expenses amounted to £13,717 (£12,191), leaving a gross profit of £16,476, an increase of £2,132, to which was added dividends and rents, making a total of £16,553. Capital charges, &c., absorbed £16,255, and there was a net surplus of £298, as compared with a deficit of £1,907 in the previous year. The capital expenditure during the year amounted to £24,847.

New Plant.—The Town Council has decided to erect a building for the accommodation of a 3,000-kW set, and to make provision for additional generating and boiler plant. The cost of the scheme is £15,556.

Torquay.—Electricity Supply.—At a recent meeting of the Town Council it was reported that a company was negotiating for the acquisition of a controlling interest in the Teignmouth electricity undertaking and in the event of obtaining it intends to apply to the Electricity Commissioners for an Order authorising it to take a supply of electricity in bulk from the Newton Abbot station of the Torquay Corporation and supply in the urban district of Teignmouth and the neighbouring parishes on the north side of the River Teign. An application has also been received from the Central South Devon Electricity Co. for an Order authorising it to supply electricity in certain parishes on the north side of the River Teign. It was decided that the heads of the agreement suggested with the first named company be submitted to it for preliminary approval, and the town clerk was instructed to lay before the Electricity Commissioners the views of the Corporation upon the two applications.

West Ham.—Loan Sanctioned.—The Town Council has received the sanction of the Electricity Commissioners to a loan of £15,250 for plant for the electricity works.

Wigan.—Inauguration of New Plant.—On May 1st the Mayor started one of the latest British Thomson-Houston 5,000-kW sets at the Bradford Place main generating station. It is reported that the Corporation is now in a position to supply all demands that may be made for several years to come. There are now 9,000 consumers.

Tramway and Railway Notes.

Australia.—Melbourne.—Owing to the refusal of the authorities to reinstate a tramcar worker, dismissed for insubordination, over 3,000 tramway employés came out on strike on May 4th. The Tramway Board dismissed the whole of the strikers on the ground that the strike involved the repudiation of the workers' contracts.

Sir Alexander Peacock, Premier of Victoria, is acting as mediator, and an agreement was prepared providing for the reinstatement of the employés, including the insubordinate officer. It was also stipulated that there should be no victimisation of the men and no loss of superannuation rights. This agreement was rejected by the men. Mr. Justice Gowers, president of the Arbitration Court, ordered a compulsory conference of the parties to take place on May 13th.

Continental.—Italy.—After four years' negotiations, the electrification of the Foggia to Benvenuto State railway has received official sanction. It is the only part of the State railway network which will use high-pressure continuous current. The outlay for the conversion was estimated in 1921 at 48,000,000 lire, but will now amount to 1,274,000,000 lire.

The State Railway Administration has decided to allot the electrification of the sections of the State railways Voghera to Milan and Chiasso, and Verona to Brennero to private industry. The contract includes the supply of the electricity required for the working and the upkeep of the line for a period of 30 years.

The scheme for constructing a third funicular railway in Naples has received Government sanction. The line will be constructed from the Galleria Umberto I. to Vomero Nuovo.

Belgium.—The Députation Permanente of Brabant has sanctioned the electrification and extension of the suburban networks of Brussels, Grimberghem, Linderzeel, Meysse, &c.

France.—The recently issued report of the Chemin de Fer Metropolitan de Paris shows that 4.7 miles were added to the Paris underground railways last year and that out of the concession of 75¼ miles a total of 57½ miles are now constructed and in operation. Negotiations have been entered into with the Government with reference to the construction of a second line under the main boulevards, and also for the conversion to electric traction of several lines in the suburbs of Paris. The number of passengers carried during the past year was 468,845,000, as compared with 451,781,000 in 1922.

Keighley.—Railless Cars.—At the Town Council meeting on May 1st it was decided that work should be commenced not later than June 2nd on the conversion of the existing railled tramway routes of the town to the railless-car system. There are three routes in the town and the Utley route is the first to be converted. A single line of tramways will be maintained as long as possible. It is hoped to have the whole of the town's tramways replaced by railless cars by October. The arrangement between the Corporation and the County Council with regard to road reconstruction includes a contribution of £9,500 by the Corporation toward the cost.

London.—Bank Station Improvements.—The three new escalators at the Bank underground station were brought into service on May 7th. Other improvements have been made, and it is estimated that it will be possible to handle an annual traffic of 10,000,000 passengers.

Nottingham.—Year's Working.—The report on the working of the tramway undertaking for the year ended March 31st last shows a total revenue of £410,398, an increase of £4,298 on that of the previous year. Working expenses amounted to £319,129 (£317,041), leaving a gross profit of £91,268 (£89,067), which has been disposed of as follows:—Interest on stocks and loans, £15,632; redemption of debt £29,002; reserve and renewals, £31,633; and relief of the rates £15,000.

Rotherham.—New Tramcar Equipment.—The Tramways Committee has recommended the purchase of twenty traction motors, twenty traction controllers, and ten tramcar trucks.

Telegraph and Telephone Notes.

Australia.—Telegraph Service.—The annual report of the Postmaster-General of Australia shows that the telegraph branch of his department made a loss of £78,000 during 1922-23. The report promises speedier delivery of telegrams.—*Daily Mail.*

Ceylon.—Radio Telegraphy.—Commencing on May 1st continuous-wave transmission was introduced at the Colombo radio station and ships fitted for valve reception will thus be enabled to receive traffic from Colombo at much longer distances than at present. It is also proposed, with effect from July 1st, 1924, to broadcast time signals and weather reports both on the continuous-wave and the normal spark systems.

Imperial Telegraph System.—New Cable.—The cable ship *Faraday* left the Woolwich works of Siemens Brothers & Co., Ltd., on the 7th inst., laden with a large quantity of submarine cable manufactured by the company and destined to form the extension of the Imperial telegraph system connecting Turk's Island with Barbados, Demerara and Trinidad. The whole of the work is expected to be completed in June.

International Telephony.—Paris Conference.—As a result of last week's meetings of the International Consultative Committee on Long-distance Telephony, a Permanent Committee has been constituted which will consist, for the year, of 11 members representing the following countries:—Great Britain, France, Germany, Austria, Belgium, Italy, Holland, Sweden, Switzerland, Czechoslovakia, and Yugoslavia. M. Milon, Directeur de l'Exploitation Téléphonique in France, will be the chairman. It was also decided to establish a permanent Secretariat, whose headquarters will be temporarily fixed at Paris.—*The Times.*

Portugal.—Telegraphists' Strike.—The "higher" telegraph and postal staffs struck work at Lisbon on May 10th. The Government forcibly ejected the strikers on account of alleged sabotage and closed the offices; subordinate officials and army officials were placed in charge to prevent the services being interrupted.—*Daily Mail.*

Radio Communication.—P.O. Workers' Demand.—A feature of the May 7th session of the Conference of Post Office Workers at Torquay was the unanimous adoption of a resolution calling upon the Government to nationalise all radio services in Great Britain.—*The Times.*

Premier's Hint.—"All that I can hope to contribute is that in the course of a month or two we may provide an efficient Empire wireless service. I know how necessary it is." The Prime Minister made this interesting remark on May 8th on his first visit to the Empire Exhibition. "Empire wireless is the next great step we have to take," he proceeded, "in the development of our Imperial communications. It must be efficient, cheap, and associated not merely with dead mechanism but we must get into our service the very best brains we can command, so that every new development will be experimented upon and established, and link up the extraordinary scientific attainments that an efficient and cheap wireless service must have at its disposal."—*Evening News.*

Linking London's Underground Railways.

The Moorgate-Camden Town Section.

THE linking of the City & South London Railway with the tube lines extending north and north-west to High-

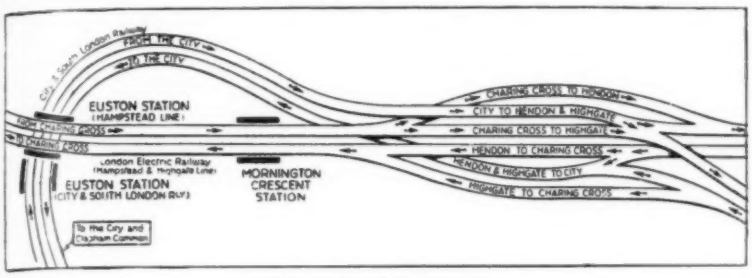


Fig. 1.—Junction Lay-out.

gate and Hendon respectively, marks the successful accomplishment of a most difficult engineering feat. Through passenger trains commenced to run to and from Moorgate on April 20th.

As the oldest tube railway in the world, the City and South London line had many drawbacks, the greatest of which was the inadequacy of its loading gauge to accommodate the up-to-date rolling stock of the more recently constructed tubes. Thus, although this railway had its terminus at Euston, physical connection between it and the newer tube railways to the northern suburbs was impossible when the older railway was absorbed in the group of the Underground Electric Railways of London.

Although Parliamentary powers to secure the much needed connection were obtained in 1913, the incidence of the war prevented a commencement of widening operations until August, 1922. The problem was complicated by the fact that junctions already existed just south of Camden Town station between the north and south bound lines to Hendon and the north and south bound lines to Highgate. Physical connection had thus to be effected between the City & South London railway, and both these sets of lines, and none of the existing lines could be crossed on the level, with the result that the two tunnels immediately south of Camden Town have had to be increased to six. The arrangement is clearly depicted by figs. 1 & 2; the former shows that the two stations at Euston are situated at right-angles to one another, but on different levels. The new railway, therefore, is carried from a point 245 ft. west of the Euston station (C. & S.L.R.) platforms in two tubes, passing under the

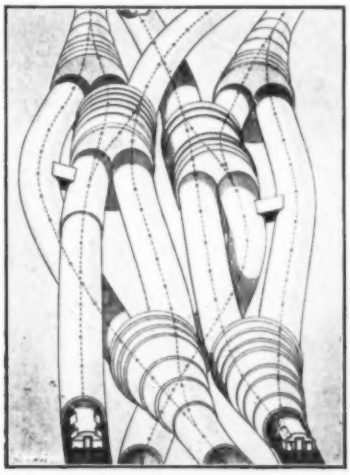


Fig. 2.—Camden Town Junctions.

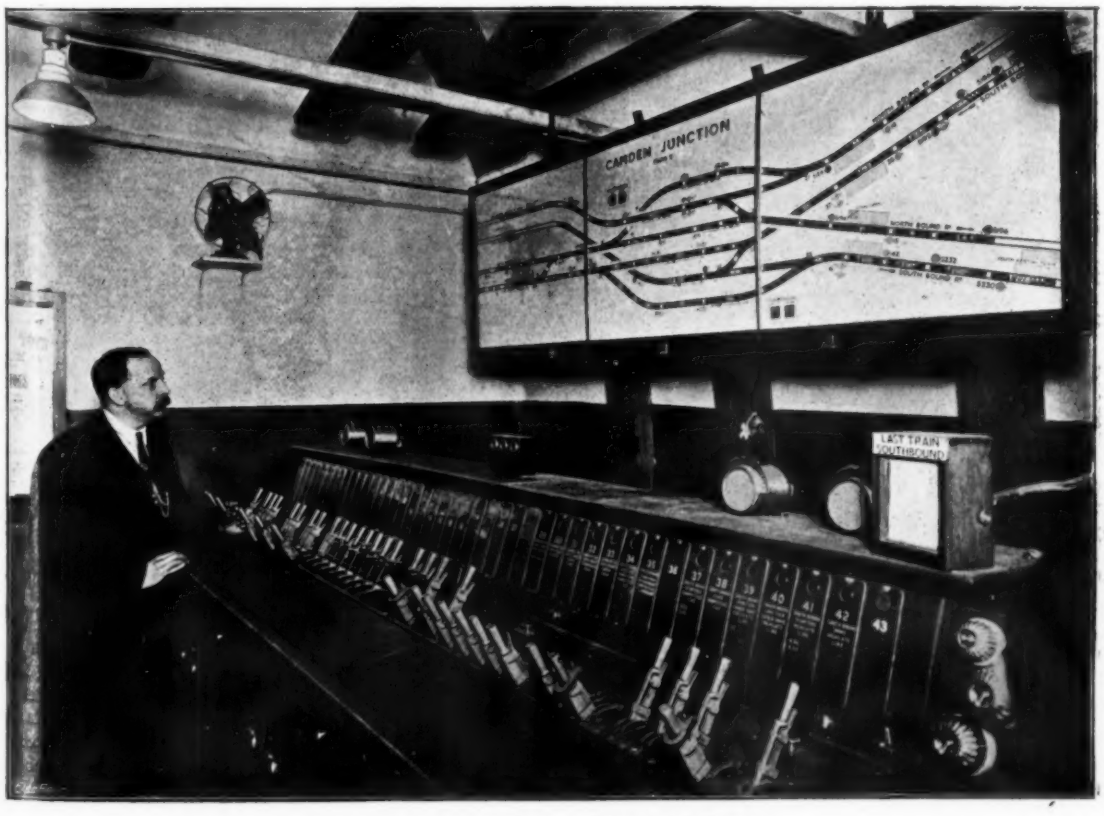


Fig. 3.—Camden Town Junction Signal Box.

Charing Cross, Euston, and Hampstead railway, and thence in a diagonal direction by a curve, approxi-

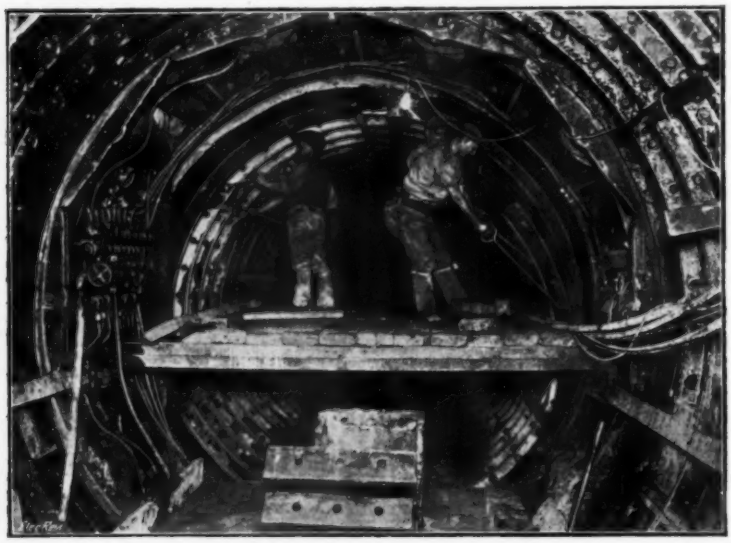


Fig. 4.—Greathead Shield and Old Tunnel.

mately 1,050 ft. in length, onwards to the commencement of the six tunnels—a point approximately 1,330 yards from Euston. On the straight, the diameter of the tunnel is the standard one of 11 ft. 8¼ in.; where all lines converge or diverge the tunnel is stepped up to 25 ft.

The whole of the work was carried on through the medium of three shafts, 60, 80, and 89 ft. deep respectively: chambers, 15 ft. in diameter, were built for each tube, and in them the Greathead shields* were erected, fig. 4, tunnelling being proceeded with in both directions. At one point the use of compressed air had to be resorted to. The most intricate work was performed at the junctions at the Camden Town end, where operations were confined to a period of four or

Fig. 5.—North-bound Tunnels.

Fig. 6.—Air-lock Entrance.

five hours each night during the suspension of traffic on the Charing Cross, Euston, and Hampstead railway. As a rule this entailed the removal of concrete from under the rails of the existing tubes, and the replacement of the segments, steel joists being installed under the tracks.

The total length of the extension from Euston to Camden Town is 5,000 ft.; the stiffest gradient against the traffic is 1 in 40 on the north bound line, whilst with the traffic the heaviest incline is 1 in 30 on the south bound line. Approximately 80,000 tons of soil were removed during the operations, and 13,000 tons of segments were fixed; six Greathead shields were employed, and the work occupied a period of only 17 months. It is interesting to note also that with such extraordinary precision has this intricate tunnelling been carried out that the margin of error in calculating the tunnel alignment has nowhere been greater than a quarter of an inch. No fewer than 17 connections have been made between new and existing tunnels without impeding in any way the normal daily traffic of the Hampstead line. Electricity is the medium for the operation of the points and signals on the new lines, which have been track-circuited throughout. The operation of the junction points and signals is performed from a signal box, fig. 3, situated on the north-bound platform at Camden Town (Highgate line). A frame of 43 levers, 37 of which are operative, made by the Westinghouse Brake and Saxby Signal Co., Ltd., has been installed, with an illuminated diagram which indicates to the signalman the condition of the lines within his jurisdiction. Separate indicators warn him of the destination of each train approaching the station. Each of the four cross-over tunnels is in telephonic communication with the signal box, so that, in the event of an emergency, drivers can get into touch, not only with the signalman, but by means of circuit switches, also with any of the officials or stations on the Underground system.

* Elec. Rev., April 6th, 1923; p. 524.

The plans for the extensions were prepared by, and the work has been carried out under the supervision of, Mr. H. H. Dalrymple Hay, consulting engineer to the Underground Electric Railways, the contractors being John Mowlem & Co., Ltd. The laying of the permanent way, conductor rails, cables, and the installation of signals, have been carried out by the railway company's own staff.

It should be emphasised that the foregoing undertaking is merely a part, albeit a vital one, of a scheme which will provide a through tube railway from Edgware in the north to Morden in the south, a distance of 25 miles. The work of enlarging the existing tunnels of the City & South London railway to enable them to accommodate the standard Underground rolling stock is proceeding apace, and the opening of the line to Moorgate, with considerably improved station accommodation there, and at Euston, King's Cross, The Angel, and Old Street, marks the first step in this great project. The next will be the resumption of the service to and from Clapham Common which, it is anticipated, will take place in the autumn, whilst the extension of the Hendon line northwards to Edgware will probably be completed by July. The third development will be the accomplishment of the southerly extension from Clapham Common to Morden, which is now being carried out. The final undertaking, so far as work at present authorised is concerned, will be the extension of the Charing Cross, Euston and Hampstead railway from its present terminus at Charing Cross to Kennington, where it will connect with the City & South London railway.

In the meantime, by the opening of the Camden Town link, passengers from the northern suburbs, including Hendon, Golder's Green, and Highgate, will have direct access to the City, and will no longer have to suffer the inconvenience of changing at Euston or Tottenham Court Road. The Camden Town extension, equipped with an all-electric signalling installation, makes it possible for 40 trains per hour to be run from each branch, or a total of 80 trains per hour from both branches; in both directions, therefore, the new junctions will have a capacity of 160 trains an hour.

Passenger cars providing a greater degree of comfort than their predecessors are being built for the through services, and a number of them have just been brought into use. The entire order entails an expenditure of £710,000 and comprises 81 motor cars, 35 control trailer cars, and 75 ordinary trailer cars. The work has been distributed between Messrs. Cammell, Laird and Co., Ltd., the Metropolitan Carriage, Wagon and Finance Co., Ltd., and the Birmingham Railway Carriage and Wagon Co., Ltd. Constructed to the specifications of the Underground Company, the coaches embody the principal features of the six experimental cars built during 1922, at the company's expense, by different rolling-stock manufacturers, with a view to arriving at the ideal car for electric railway service.

Fig. 7.—New Motor Coach.

The over-all length of each car is 49 ft. 9¼ in., width 8 ft. 6¾ in., and height (over-all) from the running rail 9 ft. 6 in. The motor cars fig. 7, will seat 30 passengers, the control trailers 44, and the ordinary trailer, fig. 8, 48. The unladen weight of the motor cars is 31 tons, and of the trailer cars 17 tons 15 cwts.

In view of the comparatively long runs which will eventually be undertaken between Edgware and Morden, all the seats are spring-borne, and the lighting also is more scientifically arranged; it is 20 per cent. more powerful than in the ordinary tube cars and, by even distribution, has been rendered free of shadows. In place of the usual entrances and exits at the ends of the carriages, there are two double pairs of doors on each side situated more towards the centre. Each door is worked by an electrically-controlled air engine, the engines being so arranged that all the doors on the train may be operated from one or more control positions. An electrical device indicates to the conductor controlling the train when all the doors are closed, and by further electrical indication the conductor signals to the driver to proceed. The traction equipment is of the all-electric type with automatic acceleration. The motors have an output of 230 b.h.p. on the one-hour rating.

Fig. 8.—New London Electric Railway Stock.

Braking is on the Westinghouse system and an electric device gives visual indication to the driver of brake application on any car. One of the most important features of the new vehicles is that the noise, akin to a roar, which has hitherto been inseparable from tube travel has been greatly reduced. This result follows extensive investigations conducted by Prof. A. M. Low. The steel sides and the floors of the cars are lined with thick asbestos, the bogies being encircled by a skirt, or shroud, of asbestos Ferodo.

Electrical Installations at the Port of Genoa.

The Most Important of Italy's Ports.

[By a Special Correspondent.]

THE gradual reconstitution of the Continental system of electricity generation and its application has proved nowhere more notable than in Italy, where direct inspiration, and frequently practical financial assistance, are being provided by the State.

Fig. 1.—Crane used for Unloading Direct to Warehouses.

Apart from the important extension that has taken place in electrically-operated railways, progress has been made in the principal ports of the kingdom, where the slower and more expensive use of steam-cranes for loading and unloading ships is fast giving place to the employment of electrically- or hydraulically-operated machinery of the latest type. This is almost exclusively of Italian make. A striking instance of the progress made is to be seen at Genoa, where the construction and re-equipment of this—the most important—port of Italy have for some years been proceeding. By the courtesy of the Consorzio Autonomo del Porto di Genova we are enabled to give some account of the port's principal electrical installations as they now are, or will be when completed.

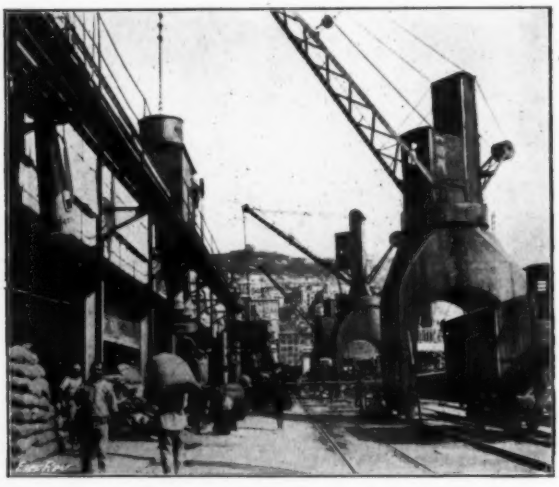


Fig. 2.—Gantry Wharf Crane.

The installations cover both "transference" from ship to wharf, and "handling" on the wharf, of incoming and outgoing cargo. Portable conveyors, full arch portal cranes spanning the railway tracks, semi-portal gantry cranes with car-tracks set flush, and at least one 6,000-lb. capacity electric gantry wharf-crane will be among the new equipment available.

On the western side, the electrical equipment consists of 13 cranes (ten of 1,500 kg. and three of 3,000 kg. capacity); one of them is an electro-magnetic lifter for unloading iron. There are also 21 elevators for handling coal, of which nine are situated on the Assereto pier, and twelve on the neighbouring Carrachiolo pier. They are of the long girder-frame type, above which are travelling turnstile cranes of 4-metric tons capacity, gross, equipped with clam-shell buckets that grasp the coal in the ship's holds, raise and shoot it into the trucks or depôts, or, alternatively, load it on to vehicles which transport it from the depôts. Each of the machines is capable of trans-shipping 50 metric tons of coal per hour. There is also in use the usual type of crane, namely, the semi-portal gantry jib crane of between 2½ and 5 tons (metric) capacity, the outer leg resting upon a rail at the edge of the quay, and the inner end resting upon a rail outside the transit shed above its doors.

Fig. 3.—Electric Pontoon Crane; 250 Tons Capacity.

The electrical installation is supplied with direct current at 550 volts from a station in the Cava Chiappella, where there is also installed an independent steam plant (at present being held in reserve). For ordinary service there is a 1,000-kW converter, which changes the h.p. a.c. into d.c.

On the Parodi Pier there is a pneumatic plant for unloading grain; the group is composed of a vertical air pump driven by a 125-h.p. electric motor, together with grain cleaners, distributors, and automatic weighing-machines, &c. Two transformers and two sorts of electrically-propelled sack-belts, for piling the sacks in the adjacent shed, complete the installation, which can handle 50 metric tons per hour. On this pier other types of electrically-driven machinery include special devices for dealing with the grain; clam-shell buckets for the hydraulic cranes; weighers and sack-fillers on trucks; hoppers running on overhead rails working around the sheds, &c. For use in the various warehouses owned by the Consorzio two hydraulic and three electric pilers have been installed. The whole of the above unloading machinery, it may be observed, is the property of the port syndicate, and is controlled directly by its own officers. The syndicate likewise owns, but lets on lease to the railway administration at the Magazzini Generali al Molo Vecchio, 17 electric trestle cranes of 1,500-kg. capacity; 12 electric cranes of similar capacity, fixed to the outside wall of the building; two travelling steam-cranes, of 3,000 and 4,000-kg. capacity respectively; six interior pilers, and thirteen turntables for truck shunting; later additions will include two electric cranes of 3,000-kg. capacity and one of 6,000 kg.

The unloading apparatus belonging to the various companies, public and private, operating at the port comprises a wide range of modern electrically-operated machinery. At the Ligure Docks, near the Morosini Pier, there are two electric cranes of 1,500 kg. capacity, two electric portal cranes of 1,500 kg., one electric crane of 1,000 kg., worked from the roof of one of the adjacent buildings, and three interior electric pilers of 1,500 kg. capacity.

On the Assereto and Paleocapa Piers there are four electric elevators of the Brown type, with fixed cabin, and a capacity for handling about 40 metric tons per hour. The Darsena Municipality has an equipment including four travelling electric cranes of 1,500 kg. capacity, one stationary gantry crane of 1,500 kg., two cranes (hammer type) of 1,000 kg. capacity, and nine interior pilers of 1,500 kg. capacity. The Magazzini Frigoriferi Militari (in conjunction with the old Magazzini Generali) possesses two electric portal cranes of 3,000 kg. capacity, with a daily unloading power of 400 metric tons of meat. From warehouse to truck the frozen meat is loaded by means of a short iron chute.

Another specially-devised plant is that of the Silos Granari, on the S. Limbania Wharf. Cereals from ships' holds are raised by means of pneumatic apparatus, including six vertical air-pumps worked by electric motors of 220 h.p. (the original steam-plant of 1,000 h.p. being held in reserve). There are 12 grain-lifting machines on a pier 100 metres in length, capable of unloading two ships simultaneously. Link-belt conveyors, elevators, automatic weighbridges, sack-fillers, unloading chutes, &c., complete this elaborate installation, which is capable of unloading and warehousing 300 tons of grain per day under ordinary conditions.

Electric Vehicles in Switzerland.—According to a recent return there are at present 596 electric motor lorries in use in Switzerland, a figure which represents about 9½ per cent. of the total.

Clyde Water Power.—The *Glasgow Herald* states that Sir Charles Ross, Bart., of Balnagowan and Bonnington, has offered his estate of Bonnington, on which are the Corra Linn and Bonnington waterfalls on the Clyde, to the Government for the purpose of providing an electricity supply for the public benefit. Sir Charles Ross is one of the parties opposing the Lanarkshire Hydro-Electric Power Bill, as reported elsewhere in this issue. Several prominent officials and members of the Lanark County Council met a number of the local Socialist M.P.s in Glasgow recently to discuss Sir Charles's offer, and to endeavour to come to some arrangement whereby any scheme that might be adopted would be worked by the County Council directly under the Government.

Radio Notes.

Broadcasting Hours.—SUMMER ALTERATIONS.—The British Broadcasting Co., Ltd., announces that certain alterations are to be made in the hours of broadcasting, which will commence on June 1st and will remain in force during the summer.

Relay Broadcasting.—THE BRADFORD STATION.—The B.B. Co. has decided, says the *Morning Post*, to erect two relay stations in the Leeds-Bradford area instead of one as originally intended.

THE LIVERPOOL STATION.—The new relay station will open officially on June 4th. The studio, in Lord Street, will terminate the trunk telephone line to London and also three private lines to the transmitter in Smithdown Lane. A line is to be leased from the P.O. for use from 5 p.m. onwards, between Liverpool and London; at the studio telephony will be amplified, and then passed over one of the three private lines to the transmitting station and radiated from there. The aerial at the transmitting station will be approximately 200 ft. long, and of the cage type. The wave-length will be between 300 and 350 m. and the power 100 watts.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Aberdeen.—May 21st. Electricity Department. Excavating, pipe laying, concrete work, &c., in connection with the extension of the circulating water system of Ferryhill power station. (May 9th.)

Australia.—MELBOURNE.—June 24th. Postmaster-General's Department. Telegraph equipment.*

Belgian Congo.—June 3rd. Belgian Ministry of the Colonies, 10, Rue Brederode, Brussels. Establishment of an electricity distribution system at Stanley Pool, Belgian Congo. Particulars, Cahier des Charges No. 915.

Belgium.—June 5th. Limbourg Provincial authorities. Establishment of a system of electricity distributing mains between Lanaye, Millen, Tongres, and Herderen, and between Rixigen and Looz, with branches to five small townships. Particulars (20 fr.) from the Service Provincial de l'Electricité, 27, Avenue Bamps, Hasselt.

May 21st. Belgian State Railway (Office de l'Electricité), 25, Rue de la Charité, Brussels. Insulated cable. Particulars, Cahier des Charges Special No. 4-34.

Burton-on-Trent.—May 27th. Board of Guardians. Electric lighting installation, administrative block, vagrants' block, laundry, &c., Institution and Children's Home. Mr. H. S. Askew, clerk.

Dublin.—May 26th. Dublin United Tramways Co. (1896), Ltd. Six months' supplies, including electric lamps, electrical fittings, &c. (See this issue.)

May 27th. Great Northern Railway (Ireland). Six months' supply of stores, including electrical fittings, lamps, cable, wire, &c. (See this issue.)

Eccles.—May 26th. Electricity Department. Twelve months' supply of single-phase a.c. meters. (See this issue.)

Edinburgh.—May 19th. Electricity Supply Department. E.h.p. switchgear for sub-stations, 3-phase transformers. (May 2nd.)

May 26th. Saughtonhall Housing Association. Electrical work for 24 houses. Specifications, &c., from R. & A. K. Smith, 44, Queen Street, Edinburgh.

Enniscorthy.—June 10th. Urban District Council. Generating sets, switchgear, storage battery, overhead mains, oil storage tank, and overhead travelling crane. (May 9th.)

Glasgow.—May 24th. Corporation. Electric lighting installation for the Merryflats housing scheme. Mr. R. B. Mitchell, 75, Waterloo Street, Glasgow.

Haddington.—County Council of East Lothian. Wiring, &c., for electric lighting at the new police station and three houses at Prestonpans. Specifications from Dick, Peddie and Walker Todd, architects, 8, Albyn Place, Edinburgh.

Irish Free State.—DUBLIN.—June 25th. Postmaster-General's Department. 50 tons h.d. copper wire; 7 tons bronze wire; 3,600 stay rods; and 25,000 spindles. (See this issue.)

Jamaica.—August 1st. Colonial Secretary. Licence for the establishment of a telephone system in Kingston and St. Andrew, Jamaica. (May 9th.)

Kirkcaldy.—May 26th. Electricity Works. Cables and roadwork. (May 9th.)

Knaresborough.—Urban District Council. Static sub-station equipment, h. and l.p. cable networks, transformer kiosks and transformers, service cables, &c. (May 9th.)

Liverpool.—May 23rd. Tramways Department. Supply of the following tramway material, *viz.* :—Steel tramway rails and fishplates, steel fishbolts, steel tie bars, and copper bonds. City engineer, Municipal Buildings, Dale Street, Liverpool.

London.—India Store Department.—May 27th. Telegraph insulators (porcelain, screwed-pattern), and telephone repeater equipment. (May 9th.)

Manchester.—May 28th. Electricity Committee. Twelve months' supply of cables, potential and current transformers, electricity meters, and time switches. (May 9th.)

New Zealand.—Wellington.—July 15th. Public Works Department. Twelve sub-station transformers for Waikato.*

Portsmouth.—Electricity Supply Department. Transformers. For particulars, see our issue of May 9th.

Salford.—May 24th. Board of Guardians. Electric wiring for lighting and power at nurses' home, Stott Lane, Pendleton. Specifications from W. T. Gimson & Son, architects, 10, Marsden Street, Manchester.

Sheffield.—June 3rd. Electricity Department. Plant required in connection with the new generating station. For particulars, see our issue of May 2nd.

Skelmanthorpe.—May 20th. Electrician's work required in connection with the erection of semi-detached houses, Commercial Road. Particulars from Mr. P. N. Brown, architect, Hollowgate, Holmfirth.

Slaithwaite.—May 31st. Urban District Council. Four-core cables and joint boxes, service connections and pillars, street lighting cables and lantern fittings, sub-station switchgear and equipment, house service meters. (May 2nd.)

Sowerby Bridge.—May 26th. West Riding Education Committee. Electric lighting scheme at schools. Specifications from secretary, Education Department, County Hall, Wakefield.

South Africa.—Johannesburg.—June 14th. Municipal Council. Motor converter and three rotary converters.*
Kingwilliamstown.—July 8th. Borough Council. Electrical plant, steam-raising plant, steel buildings, h.p. cables.*

Southampton.—May 26th. Electricity Department. Coal-handling plant and bunker extensions, &c. (May 2nd.)

South Shields.—June 4th. Electricity Supply Department. Two water-tube boilers with mechanical stokers, economisers, superheaters, and induced-draught plant and feed pumps. (See this issue.)
June 4th. Electricity Supply Department. One 6,000-kW turbo-alternator set and condensing plant. (May 9th.)

Thurles.—May 30th. Urban District Council. Crude oil engines, switchgear, distribution system, buildings, &c. (May 9th.)

Warrington.—May 27th. Electricity Department. H. and l.p. paper and lead-covered cables. (See this issue.)

West Bromwich.—May 23rd. Board of Guardians. Electric lighting installation at the Institution, Hallam House. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Belgium.—Tenders were received by the Belgian Post and Telegraph authorities in Brussels for the supply of two lots of insulated cable from four Belgian concerns and one each German, French, Danish, and Czecho-Slovakian. For the first lot of 3,747 metres of lead-covered, paper-insulated cable the lowest tender (298,430 fr.) was that of A. Cailleaux, of Brussels; for the second lot of 5,260 metres of armoured cable, a German concern, the Duisburg Kabelwerk Gesellschaft, was successful with an offer of 215,118 fr. There was a difference of no less than 103,550 fr. between the lowest and highest bids.

The Metropolitan-Vickers Electrical Co., Ltd., submitted the lowest tender to the Belgian Post and Telegraph authorities in Brussels for the supply of 175,000 insulators at 78,750 fr., and 70,000 large insulators at 91,000 fr.

Bolton.—Tramways Committee. Accepted:—
Construction of a new tramway from Deane terminus to the junction of Market Street and Church Street, Westhoughton.—G. Percy Trentham & Co. (Birmingham).

Bradford.—Tramways Committee. Accepted:—
50 chrome nickel steel axles (£255).—Vickers, Ltd., Sheffield.
Six one-man electric cars (£9,217).—Associated Equipment Co., Ltd. (London).

Electricity Committee. Accepted:—
Steam ejector feed heater for No. 7 turbine at Valley Road works.—G. and J. Weir, Ltd.
Circulating-water valves for No. 7 turbine.—Glenfield & Kennedy, Ltd.
7 electrically-operated valves and 1 retaining valve.—J. Blakeborough and Sons, Ltd.
Steel framework for foundations for No. 7 turbine.—Hall & Pickles.
Erection of district transformer chamber at Harrogate Road, Greengates.—Mitchell, Yeadon & Sons.

Colombia.—Cartagena Waterworks, Ltd,
Electric generating plant and switchgear in connection with the extension of the waterworks and the supply of electricity for lighting and power in the city and surrounding district.—British Thomson-Houston Co., Ltd.

Douglas (Isle of Man).—Education Committee. Accepted:—
Lighting installation at the new secondary school (£398).—J. C. Fargher.

Gillingham (Kent).—Town Council. Accepted:—
150-kW transformer (£148).—Hackbridge Electric Construction Co., Ltd.

Halifax.—Tramways and Electricity Committee. Accepted:—
Erection of e.h.p. overhead transmission line from Stump Cross to Spring Head and Quarry House estate, Northowram (£301).—Craven and District Electrical Construction Co., Ltd.
Partial equipment of feeder group No. 4 in connection with e.h.p. switchgear at the electricity works (£2,377).—A. Reyrolle & Co., Ltd.

Leyton.—Urban Council. Accepted:—
Switchgear for 1,000-kW motor-converter (£630).—Bertram Thomas.
E.h.p. and l.p. cable.—Enfield Cable Works, Ltd.
E.h.p. switchgear (£515).—A. Reyrolle & Co., Ltd.
4 mercury rectifiers to a total of 120 kW (£1,901).—Hewittic Electric Co., Ltd.
2 telephone switchboards and instruments (£110).—Sterling Telephone and Electric Co., Ltd.

London.—Stepney.—Electricity Supply Committee. Recommended:—
Supply of cable for 12 months.

Hackbridge Cable Co., Ltd.	£7,693
W. T. Henley's Telegraph Works Co., Ltd. (Recommended.)	**7,945**
W. T. Glover & Co., Ltd.	8,063
British Insulated & Helsby Cables, Ltd.	8,079
Pirelli-General Cable Works, Ltd.	8,084
Siemens Bros. & Co., Ltd.	8,111
Western Electric Co., Ltd.	8,133
Macintosh Cable Co., Ltd.	8,322
Callender's Cable & Construction Co.	8,513

Axial flow pump.

Vickers, Ltd. (Recommended)	**£3,000**

1,000 demand indicators.

Reason Manufacturing Co., Ltd. (Recommended) ...	**£2,107**

Wiring for electricity supply to Brook Street and Caroline Street tenements.—

L. G. Tate & Co. (Recommended.)	**£95**
Ward Bros.	152
J. G. Sneath	180

St. Marylebone.—Electric Supply Committee. Recommended:—
Instruments for boiler plant.
100 compound draught gauges (£545).—A. Wright & Co., Ltd.
8 sets of duplex "mono" recorders (£706).—J. Gordon & Co., Ltd.
Water meter (£226).—Glenfield & Kennedy, Ltd.
Bevel gear and extended chain drives for control in connection with the contract for h.p. steam mains, valves, &c. (£368).—Babcock and Wilcox, Ltd.
Extras in connection with the contract for boiler plant (£270).—Babcock and Wilcox, Ltd.

Manchester.—Education Committee. Accepted:—
Electric lighting installations at the following schools:—
Blackley Municipal School.—Ward & Booth.
Chapel Street Junior and Crumpsall Lane Schools.—Seddon & Sons.

Electricity Committee. Accepted:—
Cable.—Callender's Cable & Construction Co., Ltd.; Pirelli-General Cable Works, Ltd.
Circuit breakers.—Metropolitan-Vickers Electrical Co., Ltd.; Park Royal Engineering Works, Ltd.; J. G. Statter & Co.
Knife switches.—Park Royal Engineering Works; Ferguson, Pailin, Ltd.
Ammeters.—Metropolitan-Vickers Electrical Co., Ltd.
Steelwork for the new sub-stations in Miles Platting and Denton.—Ed. Wood & Co., Ltd.
Two 10-ton overhead travelling cranes.—Vaughan Crane Co., Ltd.
Additional 33-kV switch panel.—A. Reyrolle & Co., Ltd.

Housing Committee. Accepted:—
Electric lighting installation at houses on Wilbraham estate.—J. Armstrong & Co.

Middlesbrough.—Corporation. Accepted:—
Service cable and .1 distributor.—British Insulated & Helsby Cables, Ltd.
.035 distributor and .4 feeder cable.—Enfield Cable Works, Ltd.
1½ miles .1 sq. in. 3-core, 2,750-V cable and 1½ miles .2 x .2 x .1 l.p. three-core cable, 440 V, wire armoured (£1,212 and £1,650 respectively).—British Insulated & Helsby Cables, Ltd.

Sheffield.—Electricity Committee.
Six 11,000-V, 100-A oil-immersed switch-fuse sets (£414).—A. Reyrolle and Co., Ltd.

Stafford.—The Town Council has confirmed the acceptance of the tender of Mitchell Conveyor and Transport Co., Ltd., for the erection and completion of a turbine and boiler house for two 3,000-kW sets, including the provision of an electric crane and other works (£15,556).

Forthcoming Events.

Radio Society of Great Britain.—Friday, May 16th. At the Institution of Electrical Engineers. At 6.30 p.m. Discussion on "The Design of Transmitting Valves," to be opened by Mr. T. E. Goldup.

Institution of Welding Engineers.—Wednesday, May 21st. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 8 p.m. Annual general meeting. Paper on "Power Supply for Electric Welding Operations," by Dr. J. H. Patterson.

Royal Institution of Great Britain.—Thursday, May 22nd. At 21, Albemarle Street, W. At 5.15 p.m. Lecture on "Atmospheric Interference in Wireless Telegraphy," by Dr. E. V. Appleton. (Lecture II.)

Institution of Electrical Engineers (Western Centre).—Summer Meeting. At Torquay, Friday, May 23rd, to Monday, May 26th.

Physical Society of London.—Friday, May 23rd. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary Scientific Meeting.

The "Electrical Review" Service Department.

MR. C. H. STEPHENSON.—Will this gentleman (formerly living in the Midlands) send us his present address, as we have an urgent communication to forward to him?

Notes.

The Use of Chains.—"Safety Pamphlet" No. 3, issued by the Home Office (2nd edition) deals with the use of chains and other lifting gear, giving suitable proportions and working loads for chains, hooks, shackles, eyebolts, and slings. The Board of Trade tests are tabulated, and instructions are given for annealing, examination, &c. Many valuable hints are contained in this useful brochure.

The "Leviathan's" Radio Installation.—The radio equipment installed on the *Leviathan*, of the United States Line, has had added to it receiving equipment for tuning in stations on long and short waves simultaneously, combined with the ability to transmit and receive messages on different wave lengths at the same time. Three antennæ are used for transmission and two for reception. The transmitting installation includes one valve transmitter which is used on wave lengths of 1,800, 1,935, 2,100 and 2,400 metres. With this transmitter communication may be established with the shore, regardless of the ship's position in the Atlantic. In addition, one Radio Corporation duplex telephone and telegraph transmitter, and one 2-kW Navy standard spark set make transmission on shorter waves possible while the high-powered transmitter is being operated. Transmitting and receiving apparatus has been installed in two motor lifeboats so that communication may be established after they are launched. This plant consists of two 1/2-kW transmitters and two receiving sets equipped with two stages of amplification.

The receiving equipment in the *Leviathan* consists of the following: One Radio Corporation duplex telephone receiver, one special rejector receiver, enabling the operation of two telegraph transmitters and receivers simultaneously on 600 to 8,000-metre wave lengths, one Navy type long-wave receiver (1,000 to 25,000 metres) for listening to high-powered Government stations, one Radio Corporation receiver, 300 to 7,000 metres. Automatic break-in systems for telegraph receivers have been installed to make reception of signals possible as soon as the operator releases the key, and automatic remote control enables the operator to start generators for transmission with the least effort.

Loud-speaking apparatus can be placed on the stage and in various parts of the vessel connected direct with the radio room for the reception of broadcast programmes, and auxiliary batteries have been installed so that communication may be established in case the power supply from the engine room is interrupted. A staff of eight operators and two messengers are included in the personnel necessary for the handling of the radio equipment.

The Binghamphone.—The Commonwealth steamer *Fordsdale*, the largest ship Australia has yet built, has been fitted with an automatically-controlled speaking apparatus, which will enable conversation to be carried on under any conditions between various parts of the ship. The instrument, which is called the "Binghamphone," is the invention of an Australian, Mr. H. E. Bingham, is installed on the bridge, and is connected with the forecastle, crow's nest, steering compartment, engine-room, and docking bridge. It is reported that successful tests of the invention have been made during the trial run of the *Fordsdale*.—*Reuter's Trade Service* (Melbourne).

Development of the St. Lawrence River.—The announcement was recently made of the composition of Canada's Advisory Committee on the International Board of the St. Lawrence Power and Waterways scheme, which is as follows: Chairman, the Minister of Railways, Mr. Graham; other members, Mr. Thomas Ahearn, of Ottawa; Mr. W. E. Foster, of St. John's, New Brunswick; Mr. Beaudry Leman, of Montreal; Mr. Edward D. Martin, of Winnipeg; Dr. Wilfrid Macdougald, of Montreal; Sir Clifford Sifton, of Toronto; Major-General John W. Steward, of Vancouver; Mr. Adelard Turgeon, of Quebec.

On the Joint Engineering Board, which will consist of three engineers from Canada and three from the United States, the Canadian representatives are Mr. D. W. McLachlan, of the Federal Department of Railways, Mr. O. O. Lefebvre, chief engineer of the Quebec Streams Commission, and Brigadier-General C. H. Mitchell, of Toronto.—*Reuter* (Ottawa).

How to Stock Wire.—A well-known firm of contractors is desirous of adopting a satisfactory method of stocking wire, both enamelled and covered, so that it will be kept clean and free from damage, without presenting difficulties when the storekeeper has to issue it. Perhaps some of our readers will give us the benefit of their experience.

The Sunmill Energy Transmitter.—According to the daily Press, Messrs. Francis Milner and J. J. Dawson demonstrated at Southend on May 12th a device which they have named the "Sunmill" energy transmitter and receiver. It is claimed that their invention makes it possible to generate and transmit electrical energy over a distance without the aid of cables or wires. It is said that no matter how high the voltage is, the new method of transmission does not interfere with ordinary radio-telegraphy.

Quick-lunch Cars.—According to the *Daily Mail*, dining cars are to be introduced on the tramway between Düsseldorf and Crefeld, a run of three-quarters of an hour.

Local Societies.—ABERDEEN MECHANICAL SOCIETY.—On May 5th members of the Society visited the works of Messrs. Bruce Peebles & Co., Edinburgh. Mr. C. Bentham, works superintendent, met the party, and, with Mr. Brookhouse, chief draughtsman, Mr. Henderson (design department), and Mr. Thomson and Mr. Mackie (works staff), explained the operations. The company is busy at present and gives constant employment to 600 workers.

RADIO DISTORTION.—Mr. L. F. Fogarty recently delivered an interesting lecture on the subject of "Distortion in the Reception and Transmission of Speech and Music" to members of the Croydon Wireless and Physical Society. He dealt with both its technical and practical aspects, describing the construction of microphones, amplifiers, and receiving sets, and reviewed various appliances and their shortcomings.

Miners' Safety Lamps Giving Warning of Gas.—At a meeting of the North-Eastern Institute of Mining Engineers, held in Newcastle-on-Tyne on April 26th, Dr. W. M. Thornton read a paper on "Safety Lamps Giving Warning of Gas." He dealt first with oil lamps which gave electrical warning, and then with electric lamps, saying that a miner's electric lamp which would indicate gas had up to the present not been introduced. The problem had two parts—one, to find a lamp which could be used as the oil lamp now was, *i.e.*, by lowering the light and examining for gas; the other, to obtain one to act as did the extinguisher type, by giving warning while the lamp was fully alight. There would be little difficulty in solving either problem if the power which could be obtained from the battery of a portable electric lamp were not so small, usually two watts, which ruled out the use of a lamp and heater in series. When in parallel the battery would not hold its voltage for the shift, and it was not practicable to increase the weight. The demand for an electric lamp to satisfy the second condition was not so urgent as was that for the first. Such warning electric lamps could be made to work readily enough on a system of lighting in which double-filament lamps were used at low voltage when being carried about and at high voltage when energy was obtained from the power mains. The power in the latter case was not restricted, and the lamp could then give up to 25 candle power simultaneously with another warning by switching the light to the lower voltage if gas appeared. He suggested a convenient way of making a single-filament miner's lamp indicate gas. The chief difficulty in making electric lamps to indicate gas was to get a current of air to pass over the heater at the proper rate. If it was too slow the extra heating effect of the gas would be too small to be observed; if too fast, the heater would be cooled by the air current more than it was heated by the gas present. With only two watts available, the electric heater was not sufficient to maintain the desired air current by thermal action alone and to detect gas, unless a very sensitive indicator was used. Some form of small pump or blower, such as that in a scent spray, greatly accelerated the rate of detection, but the delivery must be through a needle-valve in order that the rate of flow might be steadied.

Fatalities.—At an inquest at St. Annes-on-Sea, on May 7th, on Joseph Yardley (52), of Hadfield, Derbyshire, employed as an erector by the English Electric Co., Manchester, a verdict of "Accidental Death" was returned. It was said that Yardley went to the substation at St. Annes to fit washers on the oil gauge of an electric transformer. The work was finished when a slight flash was seen by George Ellcoat, a mechanic, and Yardley was found lying on the floor. The transformer was not "dead," Yardley stating that it did not matter, as he would soon get it done. The Coroner said that no one could say exactly what had happened.

SOUTHPORT.—The South-West Lancashire Coroner, Mr. S. Brighouse, opened an inquest at Southport last week on the body of Francis Cyril Mellor, an electrical engineer in the service of the Birkdale Electricity Supply Co., Ltd. Mellor was found unconscious on the morning of May 3rd close by a Diesel engine. The coroner adjourned the Court until Monday, May 12th, for the attendance of the Divisional Electrical Inspector and the Inspector of Factories and Workshops.

Kelvin Centenary.—The members of the Kelvin Masonic Lodge No. 3,736 will hold a special centenary meeting on June 20th in order to commemorate the birth, on June 26th 1824, of William Thomson, Lord Kelvin. This meeting will be of interest to all engineers who are members of the craft, and the Worshipful Master and brethren of the Lodge will be pleased to welcome those who would like to associate themselves with the celebration. Full particulars may be obtained from the secretary, Mr. H. W. S. Rentell, 56, Maiden Lane, London, W.C.2.

Standardising Electricity Supply in Australia.—The following engineers have been appointed members of a committee formed to devise a scheme for the gradual development and extension of power supply systems throughout the Commonwealth, so as to secure the standardisation of voltage of supply and uniformity in the work carried out in the various States :—

Chairman.—Mr. J. H. Butters, chief engineer and general manager Tasmanian Government Hydro-Electric Department, representing the Tasmanian Government.

Mr. H. P. Moss, chief electrical engineer, Commonwealth Department of Works and Railways, representing the Commonwealth Government.

Mr. O. W. Brain, chief electrical engineer, New South Wales Railways and Tramways, and Mr. H. R. Forbes Mackay, general manager, Electricity Department, Sydney, representing the New South Wales Government.

Mr. H. R. Harper, chief engineer, Electricity Commission of Victoria, and Mr. F. W. Clements, managing director, Melbourne Electric Supply Co., representing the Victorian Government.

Mr. J. S. Just, chief engineer and manager, City Electric Light Co., Brisbane, representing the Queensland Government.

Mr. F. W. Wheadon, engineer and manager, Adelaide Electric Supply Co., representing the South Australian Government.

Mr. W. H. Taylor, electrical superintendent, Government Electricity Supply, Perth, representing the West Australian Government.

The suggestion for the formation of this committee emanated from the Commonwealth Government. The matter was discussed at the last Premiers' Conference, when all the States undertook to co-operate in the work, and agreed to the formation of a body to carry out the work, subject to a proviso that the *personnel* involved was to be subject to the approval of the State Governments. The Commonwealth Government, in carrying out the decision, arranged with the Commonwealth Engineering Standards Association to nominate a committee.—*Industrial Australian and Mining Standard.*

Report upon Tramway Accident.—In a report on the tramway collision at Lanehead, Burnley, last December, when two lives were lost and five passengers and the driver were injured, Lieut.-Col. Mount, Inspector of the Ministry of Transport, states that the evidence was contradictory and a conclusion of what actually took place was largely based upon conjecture. The effects of the collision upon the braking efficiency of the car from the leading end was of primary importance. It was evident the blow caused some displacement of the brake pillar which was not noticed by the motorman, and its disturbance might have affected the operation of the wheel brake and the gears of the trap break might also have been rendered stiff. The Inspector adds: "I consider Norris lost his head at the critical moment. His reasons for not applying power are inadequate. I think his failure was largely due to surprise and shock. He decided the only course was to obtain control from the rear end. In this he would have experienced no difficulty had it not been for a second collision, which rendered the situation hopeless. The case illustrates the possibility of collision causing disturbance to the brake pillar as the result of damage to the vestibule structure. I suggest that consideration be given to improvement in this respect. The pillar might be supported independently from the vestibule framework."

Institution Notes.

Institution of Electrical Engineers.—NEW COMMITTEE.—A committee, presided over by the president, has been appointed by the Council of the Institution to deal with any cases of doubt or difficulty which may arise in connection with the use of the designation "chartered electrical engineer" and all such cases should be referred to the secretary. The Council feels confident that it will receive the support of members in preserving the strict use of a title which carries with it an honourable distinction.

SOUTH MIDLAND CENTRE.—The Committee's report for 1923-24 was submitted at the annual meeting on April 30th. There have been nine general meetings and eight meetings of the Students' Section, in addition to one joint meeting and a works visit. The average attendance per meeting was 84 and the membership of the Centre (including the Loughborough Sub-Centre) is 923, an increase of 69. The office holders for 1924-25 are as follows:—Chairman: W. Lawson; vice-chairmen: F. J. Moffett and Col. J. F. Lister; Committee: R. A. Chattock, J. Dalziel, F. Forrest, Dr. C. Garrard, W. F. Higgs, R. G. Jakeman, E. J. Jennings, C. Jones, W. J. Line, T. A. G. Margary, E. R. Reynolds, G. Richardson, J. Young, and W. Wilson; hon. sec.: H. Hooper.

Junior Institution of Engineers.—On May 2nd, Mr. F. H. Taylor, A.M.I.E.E., delivered a lecturette on "Electric Lighting in Churches." Mr. Taylor said that a good scheme of lighting in a church must in the first place preserve the religious atmosphere, and also show harmony with the architectural surroundings and not detract from the beauty of the decorations. The best wiring system was undoubtedly screwed steel conduit, giving good electrical efficiency and freedom from fire risk. To obtain economy in working and to avoid any large extinction of light, it was necessary for the nave to have its lighting fed from several circuits. Alternate lighting units were best switched together, and preferably where each lighting unit consisted of from 4 to 5 lamps, it should be possible to light each fitting by two or more stages. For the general lighting, pendant fittings of the corona pattern suspended from the roof gave the best results, and at the same time offered an opportunity for artistic design. Concealed lighting at or above the capitals of the pillars sometimes allowed a fuller appreciation of the architecture of the church, and the source of light was quite out of the line of vision of the congregation. The chancel lighting should be the subject of special treatment, and instead of the usual standard lamps fixed to the floor, lighting units concealed in the window recesses provided good illumination on the altar. The saving in cost of lighting by electricity instead of gas naturally varied with the prices of supply in the district, but in many cases this saving would probably be found to be enough to pay for the installation in a few years' time.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Sir CHARLES STEWART ADDIS, K.C.M.G., has been elected a director of the Eastern Extension, Australasia & China Telegraph Co., Ltd., in place of the late Sir Albert J. Leppoc Cappel.

After many years with Messrs. Baillie & Dobr'e, Mr. F. E. EVANS and Mr. BOYD DAWSON have entered into partnership with Mr. C. R. ST. JOHN, A.M.Inst.C.E., as consulting engineers, under the style of C. R. St. John & Partners, at 102, Victoria Street, S.W.1. The firm has prepared a scheme for electricity supply for Ely and district, which is now under consideration by the Ely Urban District Council.

Mr. GERALD EZARD, who has left the staff of the Yorkshire Electric Power Co., Ltd., at Dewsbury, after four years service, in order to take up a post in the engineering department of the Leicester tramways, was last week presented with a barometer and a pipe by his colleagues at Dewsbury.

Mr. CHARLES DORMAN (of Dorman, Long & Co.), who presided at the 55th anniversary dinner of the Middlesbrough and District Association of Foremen and Chief Draughtsmen on Saturday last, paid a tribute to the Association's president, Mr. Andrew Davidson, who is in charge of the electrical plant at the firm's works. He said that if Messrs. Dorman, Long did not pay any dividend last year it was not because they had not cheap electricity, for he thought their electricity was very cheap. Later in the evening Mr. DAVIDSON said that when he joined the firm 30 years ago they had a 40-h.p. dynamo. "We thought it was a wonderful thing, and it was, but to-day we have over 100,000 h.p. It shows marvellous development, and I see no reason why it should not go on."

Next month Mr. L. C. F. BELLAMY, manager of the St. Helens (Lancs.) tramway undertaking, leaves for Hong Kong, to take up the position of manager of the Hong Kong tramways. He will be succeeded by Mr. F. H. GLOVER, who for the last four years has been chief assistant engineer of the Reading tramways.

Mr. F. M. JONES, B.Sc., who was formerly with the B.T.-H. Co., Ltd., Rugby, and recently with Messrs. W. H. Allen, Sons & Co., Ltd., Bedford, has now joined the engineering sales staff of the Vickers-Spearing Boiler Co., Ltd., 20, Kingsway, London, W.C.

Mr. P. W. ROBSON, chairman and managing director of Clayton & Shuttleworth, Ltd., stated at the recent meeting that he would retire from the board as soon as the arrangements for the sale of the company's boiler department to Messrs. Babcock & Wilcox, Ltd., had been completed.

The Northampton Tramways Committee recommends that the salary of the manager, Mr. J. F. CAMERON, be increased from £400 to £500 per annum.

The Council of the Institution of Civil Engineers has awarded a Watt gold medal each to Mr. S. L. PEARCE, C.B.E., Corporation electrical engineer, Manchester, and to Mr. H. N. ALLOTT, for their joint paper entitled "The Barton Power Station of the Manchester Corporation and the Transmission System in connection therewith." The formal presentation of the award will be made at the opening meeting of next session, November 4th.

Last Friday afternoon at the West Ham Electricity Offices in Romford Road, a farewell presentation was made to Mr. I. LOCKWOOD, an assistant in the Mains and Distribution Department, on his leaving West Ham to take up the position of distribution engineer to the Sunderland Corporation Electricity Department. The presentation, which consisted of a canteen of cutlery, was made after a brief speech by Mr. F. W. Purse, the

engineer and manager.. Mr. W. A. Gilbert, mains superintendent, also spoke, and was followed by one or two of his colleagues. Mr. Lockwood suitably acknowledged.

Middleton Corporation has approved the recommendation of the Electricity Committee that Mr. A. M. MULLINER, deputy borough electrical engineer at Eccles, be appointed borough electrical engineer at a salary of £500 per annum.

Obituary.—MR. FRANCIS JACOB.—We regret to record the death, which recently occurred at Ellesdene, Beaconsfield Road, Blackheath, of Mr. Francis Jacob, aged 71 years. The burial took place at Charlton Cemetery on Saturday last. Mr. Jacob was educated at the Bedford Grammar School and King's College, where he was awarded the Siemens gold medal. He joined the firm of Siemens Brothers in 1873, and was for many years actively engaged in designing and laying submarine cables, including the following: Brazilian cable for the Platino-Brazileira Telegraph Co., 1873-4; Atlantic cable for Cie. Francaise du Télégraphe de Paris à New York, 1879; Atlantic cables for the Western Union Telegraph Co., 1881 and 1882; Atlantic cables for the Commercial Cable Co., in 1881, 1894, and 1900, &c. Mr. Jacob was the inventor of the multiple twinning system for cables which is now universally adopted, and also of numerous testing devices and apparatus, including the Jacob's relay for submarine telegraphy. He was one of the oldest members of the Physical Society, and was regarded as perhaps the greatest authority on cables. He contributed the article on this subject to the "Encyclopædia Britannica." For many years he was the chief electrician at Messrs. Siemens Brothers' Woolwich works, and in 1914 was appointed the works general manager. He retired from the latter position in June, 1921, having completed nearly 50 years' service with the company.

MR. C. E. L. BROWN.—We regret to learn that Mr. Charles Eugene Lancelot Brown, so well known to the electrical world as one of the founders of Brown, Boveri & Co., of Baden, Switzerland, passed away at his home in Montagnola, on May 2nd, after a short illness. We shall refer further to this distinguished Englishman's career in a later issue.

MAJOR S. UTTING.—We briefly referred to the death of Major Samuel Utting, M.I.Mech.E., A.M.I.E.E., in our last issue. His death came as a great shock to all who had been associated with him. He was taken ill on April 24th, and his condition immediately became serious. Later he appeared to be recovering, but complications set in and he passed away on Sunday, May 4th. After several years' general engineering experience, Major Utting definitely associated himself with fuel economy in 1911, and in 1912 started business on his own account. Since that date, he had been the British representative for the Louis Prat system of induced draught and was responsible for the installation of this type of plant in many central stations and industrial works throughout this country. The most notable example is at the new Prince's Station at Nechells, Birmingham, where extensions are being carried out at the present time. After the war, Major Utting devoted a good deal of attention to the preheating of air both for boiler furnaces and industrial purposes. From 1914 to 1919 Major Utting served with the British Forces in France and Flanders and was commanding officer of various units of the Mechanical Transport section. By his death, the engineering profession has lost an ardent fuel economist. We understand that his business will be carried on as usual at the same offices, 82, Victoria Street, S.W.1, and all communications regarding Prat draught, air heaters, &c., should be addressed there.

Will.—MR. ROBERT HUNTER, ironfounder, and a director of the Falkirk & District Tramways Co., Ltd., left £46,295 personal estate.

New Companies Registered.

W. Bland, Ltd. (197,606).—Private company. Registered April 30th. Capital, £3,500 in £1 shares. To carry on the business of manufacturers of wood fittings for the electrical trades, cabinets for gramophones, cabinet makers, timber merchants, joiners, sawmill proprietors, planing and moulding mill proprietors, general wood turners and carpenters, warehousemen, building material merchants, painters and decorators, general furnishers, &c. The first directors are:—H. B. Prentice, 23, Hyde Park Villas, Hyde Park, Leeds; R. N. Appleton, 14, Crossback Road, Ilkley; W. A. Bland, 30, Grosvenor Place, Leeds. Qualification, 100 shares. Manager: W. A. Bland. Registered office: 2, Low Hall Mills, Holbeck, Leeds.

Rodo Patents, Ltd. (197,734).—Private company. Registered May 6th. Capital, £1,000 in £1 shares. To carry on the business of wireless, radio, and electrical engineers, manufacturers of and dealers in all kinds of electrical apparatus, machines, accessories, and goods, including the repairing and reconditioning, manufacturing, and dealing in valves used in wireless telegraphy and telephony, &c. The permanent directors are:—C. V. Dowding (chairman), 215, Hainault Road, Leytonstone, E.11; K. D. Rogers, "Hillsboro'," Radlett, Herts.; S. E. Dowding, 9, Warwick Road, Thorpe Bay, Essex; F. E. Kewley, "Woodstock," Highbury Grange, Highbury. Qualification, 250 ordinary shares. Remuneration, £100 each per annum (chairman £150). Registered office: 15, Grape Street, Shaftesbury Avenue, W.C.1.

P. V., Ltd. (197,775).—Private company. Registered May 7th. Capital, £10,000 in £1 shares. To take over the business of electrical and general merchants carried on by W. A. Jones and J. H. Ward at 31, Quay Street, Manchester, as "Jones, Wood & Ward." The first directors are:—W. A. Jones, 31, Quay Street, Manchester, electrical engineer; J. H. Ward, 31, Quay Street, Manchester. Qualification, £100. Remuneration as fixed by the company. Solicitor: M. Rigby, 15, Cooper Street, Manchester. Registered office: 31, Quay Street, Manchester.

Neutron, Ltd. (197,687).—Private company. Registered May 3rd. Capital, £500 in £1 shares. To carry on the business of manufacturers of and dealers in mineral ores and other substances used as crystal detectors for wireless receiving sets, particularly the crystal known as "Neutron," chemical compounds, metals and mineral ores, wireless sets, and accessories, &c. The first directors are:—W. Bennison, F.C.S., Ph.C., 9, York Mansions, Earl's Court, S.W., manufacturing chemist; T. E. de Vries, 58, Staines Road, Hounslow, engineer; T. Hadley, B.Sc., Cotes Heath, Stafford, metallurgical chemist. Qualification, £1. Remuneration as fixed by the company. Secretary: J. M. Bush, 170, Winchester Road, Higham Park, E.4. Solicitor: S. Teff, Bank Chambers, 232-236, Bishopsgate, E.C. Registered office: Sicilian House, Sicilian Avenue, W.C.1.

Monks & Byrne, Ltd. (197,620).—Private company. Registered May 1st. Capital, £2,000 in £1 shares. To acquire the business of electrical and mechanical engineers and dealers now carried on by W. Monks and G. B. Byrne at 28 and 30, High Street, Chorley, as "Monks and Byrne." The permanent directors are:—W. Monks (managing director), 91, Devonshire Road, Chorley; J. B. Jolly, "Yenton," Queen's Road, Chorley; J. Stanton, 44, Ashfield Road, Chorley; G. B. Byrne, "Blantyre," Crosby. Qualification, 100 shares. Remuneration, £40 per annum divided between them. Solicitor: J. Stanton, Chorley. Registered office: 28-30, High Street, Chorley, Lancs.

British Wireless Supply Co. (1924), Ltd. (197,757).—Private company. Registered May 7th. Capital, £1,500 in £1 shares. To carry on the business of wireless, electrical, mechanical, and general engineers and contractors, manufacturers and sellers of wireless instruments, &c. The permanent directors are:—W. Mitchell, 7, Parkfield Road, Bradford (director of Traffic, Ltd.); G. W. Cannell, "Vennersholme," Newlaithes Road, Horsforth. Qualification, £100. Manager: G. W. Cannell. Registered office: 6, Blenheim Terrace, Leeds.

Official Returns of Electrical Companies.

Southwark Electric Co., Ltd.—W. L. Sibley, of 23, King Street, E.C., was appointed receiver on May 1st, 1924, under powers contained in debenture dated June 8th, 1923.

H. Maguire, Ltd.—R. W. Lofthouse, of 1, High Street, Hull, was appointed receiver and manager on May 2nd, 1924, under powers contained in debenture dated November 9th, 1923.

Evans (Electrical), Ltd.—W. L. Sibley, of 23, King Street, E.C., was appointed receiver on May 2nd, 1924, under powers contained in debenture dated March 14th, 1922.

Charles Fer & Co., Ltd.—S. P. Child, of 36 and 37, Queen Street, E.C., ceased to act as receiver or manager on April 29th, 1924.

Baker & York, Ltd.—D. W. H. Phipp, of Lord Haddon Road, Ilkeston, was appointed receiver on April 25th, 1924, under powers contained in debenture dated April 19th, 1922.

Marston Billington, Ltd.—L. R. Stevens, of 5, Guildhall Chambers, Basinghall Street, E.C., was appointed receiver on May 1st, 1924, under powers contained in debenture dated May 27th, 1920.

Cookham and District Electricity Corporation, Ltd.—Satisfaction in full on April 1st, 1924, of debentures dated August 31st and November 23rd, 1921, and January 11th and February 28th, 1922, securing in all £15,122 8s. 10d.

Commercial Telephone and Electrical Co., Ltd.—Particulars filed of £300 debentures authorised March 3rd, 1924, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Cark and District Electricity Co., Ltd.—Particulars filed of £1,000 debentures authorised February 2nd, 1924, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Acme Production Co., Ltd.—Mortgage debenture dated April 10th, 1924, to secure £3,000, charged on the company's undertaking and property, present and future. Holder: F. L. Fulford, Manor House, Aston le Walls, Byfield.

Hindhead and District Electric Light Co., Ltd.—Issue on April 24th, 1924, of £100 debentures, part of a series already registered.

Douglas Southern Electric Tramways, Ltd. (45,701).—Return dated December 26th, 1923. Capital, £50,000 in 30,000 preference and 20,000 ordinary shares of £1 each. 25,973 preference and 15,472 ordinary shares taken up. £18,370 paid on 12,566 preference and 5,804 ordinary shares. £23,075 considered as paid on 13,047 preference and 9,668 ordinary shares. Mortgages and charges, £1,376 13s. 6d.

Blackpool and Garstang Electric Light Railway Co., Ltd. (62,150).—Return dated December 31st, 1923. Capital, £10,000 in £5 shares. 361 shares taken up. £4 per share called up. £1,707 paid (including £323 received on application for further shares not allotted), £60 in arrears. Mortgages and charges, nil.

Harrow Electric Light and Power Co., Ltd. (44,529).—Return dated March 6th, 1924. Capital, £50,000 in 6,667 ordinary and 3,333 preference shares of £5 each. All shares taken up. £50,000 paid. Mortgages and charges, £25,000.

City Notes.

Electric Supply Corporation, Ltd.

The report for 1923 states that the directors, having purchased on the market a portion of the debenture issue, decided to pay off the remainder, and at the end of the year all but a small amount had been redeemed. During the year the company's capital was increased to £350,000 by the creation of 200,000 new £1 shares, of which 150,000 were cumulative preference shares (6 per cent.) and the remainder ordinary shares. The whole of the preference shares were issued and taken up. The gross earnings increased by £9,156 to £91,339, and the sum taken into net revenue account was £38,878. After deducting interim dividends and other charges there remained a balance of £28,812. It was proposed to transfer £10,000 to depreciation fund, £2,639 to general reserve fund, to write £815 off the

expenses of the preference issue, and to pay a final dividend at the rate of 15 per cent., less tax, making 10 per cent. for the year. The remarks regarding the working of subsidiary companies show that the Dawlish Electric Light & Power Co. paid 7½ per cent. on its ordinary shares; the Hendon Electric Supply Co., Ltd., 15 per cent.; and the North Berwick and District Electric Light & Power Co., Ltd., 10 per cent.

Madras Electric Tramways (1904), Ltd.

Mr. A. M. Quill (chairman) presided at the annual meeting on May 7th, and in presenting the report and accounts (*vide* Electrical Review, April 18th, p. 626), said that the year marked the return of the company to its former prosperity. The results had been obtained in the face of keen motor omnibus competition; he regretted that the Madras Corporation had not acceded to the request for the prohibition of motor transport on the company's routes. The company had agreed to extend the system across the island if the track rental was abolished, a reduction made on car licences, the company relieved from maintaining the track, which was seriously affected by competitive motor vehicles, and if the Corporation assisted in the construction by guaranteeing interest on the outlay during the period of development. The Corporation was sympathetic, and it was hoped that agreement would soon be reached. Feeling confident of this, they had taken the opportunity of raising £130,000 last month by the issue of 5½ per cent. debentures. This was used, partly, to pay off the outstanding 5 per cent. debenture stock, which carried with it a number of restrictive clauses.

The traffic continued to develop satisfactorily; the number of passengers carried had risen from 17,320,038 to 18,449,301, and the receipts from 11,58,492 rupees to 12,59,438 rupees. While the receipts increased by 8.7 per cent., the running expenses were reduced by 4.9 per cent.

The chairman then briefly reviewed the accounts, and concluded by stating that steps were being taken to convert the existing £5 preference and ordinary shares into five shares of £1 each.

Johnson and Phillips, Ltd.

In their report for the year ended December, 1923, which was submitted at the annual meeting held yesterday (Thursday), the directors showed that the profit on trading account, &c., after making provision for bad debts, and after charging to revenue upwards of £14,000 for maintenance of buildings, plant, &c., amounted to £89,614, plus £18,114 brought forward. From the total, £107,728, the following are deducted:—Remuneration of directors and auditors, and trustees' fees, £1,562; interest on 8 per cent. debenture stock, £26,782; reserve *re* 8 per cent. debenture sinking fund, £15,217; income tax and corporation profits tax, £5,120; depreciation on machinery and plant, &c., £12,218; leaving £46,829. A dividend at the rate of 5 per cent. per annum on the ordinary shares, less income tax, requires £21,875, leaving to be carried forward £24,954.

Automatic Telephone Manufacturing Co., Ltd.

The directors report a profit for the year ended December, 1923, amounting to £95,167, plus £6,487 brought forward, making a total of £101,654. From this are deducted directors' fees, £2,850; debenture interest, £13,650; depreciation on patents, goodwill, buildings, plant and machinery, £25,000; remainder of development expenditure written off, £8,000; remainder of debenture issue expenses written off, £4,000; proportion of discount on debentures issued written off, £4,000; transferred to general reserve fund, £5,000; written off investments, £599; dividend on preference shares, £12,000. There remains an available balance of £26,555, out of which a dividend of 3 per cent., less income tax, on the ordinary shares is recommended for the year (as compared with no dividend for 1922), absorbing £10,800 and leaving £15,755 to be carried forward. "A steady volume of output has been maintained throughout the year, and the results show a substantial improvement," a dividend being recommended and the balance-sheet considerably strengthened. Meeting: Liverpool, June 5th.

Northern General Transport Co., Ltd.

The total net receipts amounted, in 1923, to £73,216, and after the deduction of administration expenses, and loan and debenture interest, and providing £27,559 for renewals, there remains £32,447. To this is added £971 brought forward, making £33,418. The preference dividend is paid, £5,000 transferred to reserve, £1,849 carried to debenture sinking fund, a dividend at the rate of 7½ per cent. is paid on the ordinary shares, and £3,013 is carried forward. The company's investments in the Gateshead and District Tramways Co., the Tynemouth and District Electric Traction Co., Ltd., and the Jarrow and District Electric Traction Co., Ltd., are valued at £419,408.

French Companies.

The *Compagnie Générale de Télégraphie Sans Fil* maintains the rate of dividend for 1923 at 40 fr. per share.

The gross profit of the *Compagnie Electro-Mécanique* amounts to 4,344,000 fr. for 1923. It is proposed to set aside 4,058,000 fr. for depreciation and to carry the balance forward.

The *Compagnie Radio Electrique* reports a reduction in the gross profits for 1923; the net profits fell from 3,455,000 fr. in 1922 to 1,924,000 fr. last year. The rate of dividend, which was 25 fr. per share in 1922, is expected to be about 13 fr. for 1923.

The *Compagnie Radio-Maritime*, after making provision for depreciation, reports net profits and balance forward amounting to 1,439,000 fr. for 1923, or substantially the same as in 1922. Dividend 18 per cent. (18 fr.) as against 25 fr. per share in 1922.

The *Compagnie Générale des Câbles de Lyons* reports a net profit of 772,000 fr. for 1923, after making provision for depreciation, as compared with 884,000 fr. in 1922. Dividend at the rate of 40 fr. per share, as against 30 fr. per share in 1922.

The report of the *Société de l'Electricité du Canton de Lens*, which has a capital of 2½ million fr., shows that the net profit last year amounted to only 28,393 fr., as compared with 12,017 fr. in 1922.

Swedish Companies.

The accounts of the *Allmanna Telefon A.B., L.M. Ericsson*, for 1923, are reported to show a surplus of 2,250,000 kr., or about the same as in the preceding year. It is proposed to pay a dividend at the rate of 5 per cent. as in 1922.

The report for 1923 of the *Svenska Ackumulator A.B. Jungner* states that the turnover increased by 35 per cent.; the demand for the company's manufactures showed a favourable advance and many orders were received both from Swedish customers and from abroad. The Nife accumulator had been able successfully to compete with foreign products and production of this type had now begun at the Stockholm works. In the case of the English subsidiary—Batteries, Limited—a new issue of 6,000 ordinary shares and of 28,850 £1 preference shares at par had been made. The firm of Pritchett and Gold and E.P.S. Company, which will co-operate in the sale of Nife batteries for train lighting, is stated to have subscribed 6,000 ordinary and 14,000 preference shares and the Jungner Company 14,850 preference shares. As compared with a loss of 133,000 kronen in 1922 the accounts for 1923 show net profits of 59,000 kr., permitting of the payment of the dividend on the preference shares for 1921 and 1922 and the carrying forward of 2,327 kr. The share capital amounts to 2,520,000 kr.

Prospectuses.

North Wales Power Co., Ltd.—The list of applications is to close to-day in an issue of £1,500,000 4½ per cent. guaranteed debenture stock 1930-1953 in this company. Our readers will remember that this stock is guaranteed as to principal and interest under the provisions of the Trade Facilities Acts, 1921 and 1922. The price of issue is £95 10s. per cent. The prospectus states that the issue is made for the purpose of "(1) Harnessing the water power of the River Prysor near Maentwrog in Merionethshire, and building an additional generating station there with an initial capacity of 16,000 h.p., with additional spare plant of 4,000 h.p. (2) Increasing the catchment area of the company's present generating station at Cwm Dyli. (3) Extending the company's transmission line system to the town of Crewe, to the industrial districts of its Eastern area, and to the coastal towns and resorts in the Western area, entailing the construction of about 400 miles of additional lines." The net proceeds of the issue will be mainly expended in the purchase of plant, machinery and equipment manufactured in the United Kingdom, and expenditure incidental thereto.

The Electric Light and Power Contracts Finance Corporation, Ltd.—We have received copies of the prospectus of this company, but as the subject was covered in the "Stocks and Shares" article in the Electrical Review for May 2nd, page 719, we need only refer our readers to the comments there made.

International Automatic Telephone Co., Ltd.—The directors report that the profit for the year ended December, 1923, was £26,829, plus £2,755 brought forward. There has been written off preliminary and formation expenses £3,198; depreciation on office furniture, &c., £200; the preference dividend absorbs £11,853; a dividend of 4 per cent., less income tax for the year requires £8,616; and £5,709 is to be carried forward. The company is a large shareholder in the Automatic Telephone Manufacturing Co., Ltd., and as the directors of that company have recommended a dividend of 3 per cent. on the ordinary shares for 1923, this is reflected in the revenue of the International Company, and accounts largely for the improved results. Meeting: Liverpool, June 5th.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be officially quoted:—

Lima Light, Power and Tramways Co.—£1,250,000 6 per cent. first mortgage debentures, in lieu of the scrip, together with £250,000 6 per cent. first mortgage debentures (issued abroad), Nos. 1 to 18,845 (£1,000, £500, £100, and £20).

The undermentioned have been ordered to be officially quoted:—

Midland Counties Electric Supply.—975,000 ordinary shares of £1 each, fully paid (Nos. 1 to 975,000), 750,000 6 per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 750,000), and £339,030 5 per cetn. debenture stock.

Pennsylvania Water and Power.—2,000,000 dols 5½ per cent. first refunding gold bonds, series "A" (Nos. 1 to 2,000 of 1,000 dols each).

Colombo Electric Tramways and Lighting Co., Ltd.—The profit for the past year was £68,593. The directors propose a dividend of 15 per cent., free of tax, £30,700 is transferred to the general reserve and renewal fund, while £18,267 is carried forward.

Potteries Electric Traction Co., Ltd.—The report for 1923 shows that the total revenue decreased by £15,380 to £240,817, while the working expenses fell by £17,913 to £189,634. After deducting expenses, including debenture interest and £5,000 for renewals, there remains £18,261. To this is added £5,376 brought forward, making £23,637. A 5 per cent. dividend on the preference shares absorbs £12,250, and the balance (£11,387) is to be carried forward. The reserve at December 31st, 1923, stood at £108,695, and the renewals fund at £40,377. The Bill promoted by the company in the last session of Parliament, to vary the dates at which the local authorities may purchase the tramways and light railways, and for other purposes, received the Royal Assent in July last. The Act provides that should the local authorities not give six months' notice on or before December 31st, 1924, to purchase the tramway undertaking, their right of purchase will not arise again until 1950. The Corporation of Stoke-on-Trent has obtained powers to limit the number of omnibuses plying for hire in the borough, but competition has not diminished as the Corporation is not to withdraw any licences until July 31st this year.

Anglo-American Telegraph Co., Ltd.—The report for the year ended March, 1924, says that three quarterly dividends of 15s. per cent. on the ordinary stock and 30s. on the preferred were paid during 1923, and in February, 1924, final dividends of 30s. per cent. on the ordinary, preferred, and deferred stocks were paid. These payments, together with £60,703 for income tax, absorbed altogether £262,500, being the rent paid by the Western Union Telegraph Co. for the year, equal to 3¾ per cent. on the ordinary, 6 per cent. on the preferred, and 1½ per cent. on the deferred stock. The balance at credit of revenue account (£67,595) includes £1,970 interest received, and a balance of £65,625 is available for the payment of dividends for the quarter to March 31st, 1924.

Rangoon Tramways and Supply Co., Ltd.—The report for 1923 shows a net profit of £48,269, after the deduction of debenture interest, &c., taxes, depreciation, and certain other expenses. £10,000 is transferred to reserve, and £16,497 carried forward. The dividend on the ordinary shares for the year was 1½ rupees, free of tax, to shareholders resident in India and Burma. During the year £200,000 5 per cent. debenture stock was issued, making the total £300,000.

The Ever-Ready Company (Great Britain), Ltd.—The directors' report for the year ended March, 1924, shows that the amount available for appropriation is £79,312, less £25,000 allocated to general reserve. Interim dividends paid last December absorbed £13,427, and it is now proposed to pay final dividends of 6½ per cent. on both the ordinary and the preference shares, making 10 per cent. on both classes for the year, leaving £15,947 to be carried forward.

Canary Isles.—The report of the *Société de l'Electricité de las Palmas* (Canary Isles) for last year shows a net profit of 6,601 fr., as compared with 3,973 fr. in 1922, and a loss of 1,455,905 fr. up to the end of 1921. The company has a capital of 1,755,000 fr.

Melbourne Electric Supply Co., Ltd.—Interim dividend on consolidated ordinary stock of 5 per cent. actual, free of tax.

Mirrlees, Bickerton & Day, Ltd.—Dividend of 7½ per cent. per annum on ordinary shares.

Montreal Tramways Co.—A quarterly dividend of 2½ per cent. is announced.

Callender's Cable and Construction Co., Ltd.—The report for 1923 shows a balance to credit of profit and loss account of £264,086, plus £226,901 brought forward. After meeting debenture, preference share, and depreciation accounts, a dividend of 15 per cent. is recommended, less income tax, leaving £315,987 to carry forward.

Stocks and Shares.

MONDAY EVENING.

THE appetite of the public for new shares is certainly one of the outstanding features of the financial world this month. It does not matter much who the borrower may be, provided he can offer sound stock at a reasonable price. Some of the new issues made just lately have come out indeed at levels which look almost too high, taking as the standard of comparison the 5 per cent. War Loan or the new 4½ per cent. Conversion stock. Nevertheless, the public eagerly take the securities, and there are few cases nowadays in which underwriters get left with any proportion of their liability.

The Madras Electric Tramways Company recently offered 5½ per cent. first mortgage debentures at 93, and the subscription lists were closed before the advertised time, the underwriters being freed from any responsibility. Nevertheless, the price fell to 2½ discount, suggesting that a large block of stock was being offered. A subsequent rally of a point indicated that the stock was being absorbed, and, having regard to the character of the security, this is not surprising, although a good many people still fight shy of Indian investments. On the Madras Electric 5½ per cent. debentures, a partial dividend is payable next November. The yield at the present price is 6 per cent. The amount required for the interest comes to £7,150, and the sum available on last year's profits exceeded £35,000. Redemption must be effected by 1964 by drawings at 100 or by purchases through a cumulative sinking fund of 1 per cent. beginning in 1929.

Tokio Electric 6 per cent. sterling bonds have recovered from the weakness which overtook them as a result of the friction between the United States and Japan. The price fell to 87, but is now nearer 91, at which the yield is over 6½ per cent. on the money, raised to 6¾ per cent. allowing for redemption. Interest is payable in June and December. The present quotation carries five months' dividend in its price.

Another high-yielding debenture investment is the 6 per cent. first mortgage stock of the Whitehall Electric Investments, obtainable at 95½, which pays 6 guineas per cent. There is still obtainable a certain amount of British Columbia Electric Railway 5 per cent. tax free debenture stock offered at 104½, a premium of 9½ points above the issue price. The yield is 4¾ per cent. net, but the stock can be redeemed in whole or in part at any time by drawings at 100, its full length of maturity being 1944.

There will be a period of suspense during the next few weeks in the market for ordinary shares in the electricity supply companies. Until some sort of illumination appears in connection with the Bills that are to be presented to Parliament, investment is likely to remain coy about venturing further into the market for the shares, though proprietors, except those who are disposed to be a little apprehensive of the outlook, will probably retain their investments in the expectation that, whatever legislation may bring, the present dividends on electricity supply shares are likely to be maintained. Our lists show the yields on the London companies to be fairly good at existing quotations, though the tradition dies hard that, from ordinary shares, an investor should look for 8 to 10 per cent. on his money. Charing Cross ordinary at 42s. 6d. have recovered the shilling which they shed last week, and there is a slight improvement in the Newcastle-on-Tyne shares. Chelseas, however, are dull at 35s.

Home Railway stocks are weak. The result of the French elections led to prices being lowered in a good many markets round the Stock Exchange on Monday, and Home Railways suffered with the rest. The Undergrounds did not escape from the general heaviness, and with the exception of Metropolitans, which at 80¼ are 10s. higher, prices gave way. Underground income bonds fell 2, the £10 shares 5s., and Districts 1½. There seemed to be no support forthcoming, and, although quotations for pre-ordinary issues are well maintained, the speculative interest in the junior securities is slack. The weather fights against the British Empire Exhibition, and, while it is said that on some days the attendance is exceedingly good, this does not prove of sufficient attraction to induce the public to buy stocks in those railway companies which serve Wembley.

The Automatic Telephone Company has declared a dividend of 3 per cent., and the International Automatic is to pay 4 per cent., a welcome return to the dividend list in both cases. The shares of the first-named company stand at 20s., whereas Internationals are 17s. 6d., an apparent anomaly which is explained by reference to the impression that the Automatic Company possesses the wider scope for expansion. Marconis, although nominally 1 9/16, can be bought at that price or a little cheaper, the wireless group being dull as a whole. Cable stocks keep steady. Great Northerns at 29 show a rise of 10s. Anglo-American preferred at 103 is similarly better. The latter company's deferred stock remains at 23¾, at which price it provides a sound 6½ per cent. investment, having regard to the extraordinary prosperity shown by the Western Union, the guaranteeing company of the Anglo-American Telegraph.

British Electric Traction ordinary, with a rise to 81, is 5 points higher on the week. The buying is difficult to explain, but is said to come from informed sources. The company's preferred stock remains at 99½. London United Tramways preference strengthened to half-a-crown, but London and Suburban Traction preference at 5s. 6d. are 6d. down. Amongst the foreign stocks, Brazil Tractions put on another ¼, and most of the American securities which are quoted in dollars show rises ranging from 2 to 3 points, owing to the movements in the New York rate of exchange.

Siemens pursued their upward course, a rise of 1s. 9d. taking the price to 19s. 3d. For this sharp recovery during the present month, dividend hopes are responsible. It may be recalled that the company paid nothing for 1922, against an annual 10 per cent., free of tax, in the previous five years. The preference shares have risen to 25s. 6d. General Electric show a small decline. Otherwise the manufacturing group is unchanged.

Amongst iron and steel shares, a fall to 11s. 6d. in Vickers reflects uneasiness felt in regard to the dividend outlook. An announcement is due immediately. Rubber shares are weak, because the price of the produce is still a trifle under 1s. per lb. Victoria Falls ordinary shares are one of the strongest features in the mining market, the ordinary jumping to 35s. and the preference improving to 30s. 6d. Stock Exchange gossip says that there has recently been an order to buy 50,000 ordinary shares, the execution of which is the reason for the rise. But gossip does not go so far as to fix a label on the reason for the reputed large purchase.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom. £	Dividend. 1922.	Dividend. 1923.	Price May 12, 1924.	Rise or fall.	Yield. p.c.
Brompton Ordinary	1	12	10	37/-	—	*£5 8 1
Charing Cross Ordinary	1	14	14½	42/6	+1/-	6 16 6
do. do. do. 4½ Pref.	1	4½	4½	17/-	—	5 6 0
Chelsea	1	10	12	1¾	— ¼	6 17 2
City of London	1	15	15	45/9	—	6 11 0
do. do. 6 % Pref. ...	1	6	6	23/6	—	5 2 2
County of London	1	10	15	45 9	—	6 11 0
do. do. 6 % Pref. ...	1	6	6	1¼	—	5 6 8
Edmundson's Ordinary	3	7	7	5	—	4 4 1
do. 6 % Pref.	5	6	6	5¼	—	5 17 1
Kensington Ordinary	5	12	14	10	—	7 0 0
London Electric	1	10	10	31/-	—	6 9 0
do. do. 6 % Pref. ...	5	6	6	5⅝	—	5 11 7
Metropolitan	1	8⅛	10	13	—	5 14 3
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	2½	6	18/9	—	6 8 1
do. 5 % Pref. ...	1	5	5	17/8	+6d.	5 16 0
do. 7 % Pref. ...	1	7	7	24/-	+ d.	5 16 8
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	21/9	—	5 13 0
Urban Ordinary	1	—	4	18/3	—	4 7 8
do 6 % Pref. ...	1	5	6	1	—	6 0 0
St. James' and Pall Mall ...	5	14½	17½	13½	—	6 13 4
South London	1	11	15	42/-	—	6 7 2
South Metropolitan Pref. ...	1	7	7	1¼	—	5 12 0
Westminster Ordinary	5	12	15	10⅜	—	7 1 2
Whitehall Elec. Invst. 7½ % Pref.	1	7½	7½	20/6	—	7 6 4

HOME RAILS.

Central London Ord. Assented	Stock	4	4	68½	—	5 16 10
Metropolitan	,,	3½	4	80½	+ ½	4 19 5
do. District	,,	3	3½	53	—1½	6 12 1
Underground Electric Ordinary	10	Nil	Nil	2¾	— ¼	Nil
do. do. "A" ...	1	Nil	Nil	8/-	—	Nil
do. do. Income	Bonds	5	6	95	—2	*6 6 4

TELEGRAPHS AND TELEPHONES.

		Dividend. 1921	Dividend. 1922			
Anglo-Am. Tel. Pref.	Stock	6	6	103	+ ½	5 16 6
do. Def.	,,	1½	34/6	23½	—	6 8 4
Chile Telephone	5	6	6	6	—	5 0 0
Cuba Sub. Ord.	10	7	7	6⅞xd	—	10 7 4
Eastern Extension...	10	10	10	17½	—	5 16 8
Eastern Tel. Ord.	Stock	10	10	173½	—	5 15 3
Globe Tel. and T. Ord.	10	10	10	18	—	5 11 1
do. do. Pref.	10	6	6	10¾	—	5 10 4
Great Northern Tel.	10	24	23	24	+ ½	7 11 8
Indo-European	25	10	7	33½xd	+ 1	*5 6 1
Marconi	1	25	15	1⅞	—	9 12 0
Oriental Telephone Ord.... ...	1	12	12	13	—	*6 8 0
United R. Plate Tel.	5	8	8	7	—	*5 14 6
West India & Panama	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	17½	—	5 16 9

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams First Pref....	5	5½	12½	8½	—	8 9 0
do. do. 2nd Pref. ...	5	Nil	5½	2⅛	—	10 4 4
do. do. 5% Deb. ...	Stock	5	5	73½	—	6 16 8
British Electric Traction Ord. ...	,,	4½	5	81	+5	6 3 7
do. do. 6% Pref. ...	,,	6	6	99½	—	6 0 6
Brazil Traction	100	Nil	4	58	+ ½	6 18 0
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	84½	—	5 18 4
do. do. Preferred	,,	5	90/-	84½	—	*5 14 0
do. do. Deferred	,,	8	127/-	103	+ ½	*6 5 0
do. do. Deb.	,,	4½	4½	78½	—	5 8 8
Lond. & Sub. Trac. 5 % Pref. ...	1	8½	5	5/6	—6d.	9 1 10
London United Tram. Deb. ...	Stock	4	4	47	—	8 10 2
Mexico Trams. 5% Bonds ...	—	Nil	Nil	73½	—	6 16 0
do 6% Bonds ...	—	Nil	Nil	50½	—	Nil
Mexican Light Common ...	100	Nil	Nil	22½	—	Nil
do. Pref.	100	Nil	Nil	46½	—	Nil
do. 1st Bonds ...	—	Nil	5	68½	—	7 6 0

MANUFACTURING COMPANIES.

Babcock & Wilcox...	1	15	20	23	—	*5 1 1
British Aluminium Ord.... ...	1	10	5	23/3	—	4 5 10
British Insulated Ord.	1	15	15	2½	—	6 0 0
Callenders	1	15	15	48/9	—	6 3 0
do. 6½ Pref....	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	10	5	⅞	—	8 17 10
Edison-Swan	4/-	Nil	7½	5/-	—	6 0 0
do. ,, 5% Deb.	Stock	5	5	79½	—	6 7 5
Electric Construction	1	10	10	1⅝	—	6 7 5
English Electric	1	8	5	16/9xd	—	5 19 3
do. do. Pref.	1	6	6	19/-	—	6 6 4
Gen. Elec. Pref.	1	6½	6½	23/6	—	5 10 8
do. Ord.	1	10	5	20/6	—6d.	4 17 7
Henley	1	15	15	49/6	—	6 1 2
do. 4½ Pref.	5	4½	4½	4⅜	—	5 9 1
India-Rubber	1	10	12	1½	—	*7 5 6
Met.-Vickers Pref....	2	8	8	3⅛	—	6 11 2
Siemens Ord.	1	10	10	19/3	+ 1/9	Nil
Telegraph Con.	12	20	20	24	—	*5 0 0

* Dividends paid free of Income Tax.

Market Quotations for Chemicals and Metals.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances

CHEMICALS, &c.	Price May 13.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	5½d.	...
a Ammoniac, Sal ... ... per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£52	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£25	...
a Copper Sulphate ... ... ,,	£35 10s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ... ,,	4½d.	...
a Shellac ... ... per cwt.	£15 15s.	...
a Sulphur, Sublimed Flowers ... ,,	£7 15s.	...
a ,, Roll ... ... ,,	£7 15s.	...
a Soda, Chlorate ... ... per lb.	3d.	...
a ,, Crystals ... ... per ton	£5 to £5 5s.	...
a Sodium Bichromate, casks ... per lb.	4½d.	...
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£125 to £130	...
b ,, Wire ... ... per lb.	1/9 to 2/6*	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... ... per ton net	£213	£12 dec.
Grade II ... ... ,, ,,	£152	£9 dec.
Grade III ... ... ,, ,,	£85	£4 dec.
c Brass (rolled metal 2" to 12" basis) ,, lb.	9¼d.	½d. dec.
c ,, Tubes (solid drawn) ... ,,	1/0½d. to 1/0½d.	½d. dec.
c ,, Wire, basis ... ... ,,	10½d.	½d. dec.
c Copper Tubes (solid drawn) ... ,,	1/1½d.	
c ,, Bars (best selected) ... per ton	£96	...
c ,, Sheet ... ... ,,	£96	...
c ,, Rod ... ... ,,	£96	...
d ,, (Electrolytic) Bars ... ,,	£69	15/- dec
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, Wire Rods ... ,,	£79	15/- dec.
d ,, ,, H.C. Wire per lb.	10½d.	½d. dec.
f Ebonite Rod ... ... ,,	2/- to 3/6	...
f ,, Sheet ... ... ,,	2/- to 3/6	...
n German Silver Wire ... ... ,,	2/3	...
h Gutta-percha, fine ... ... ,,	nom.	...
h India-rubber, Para fine ... ... ,,	11½d.	...
Iron Pig (Cleveland Warrants) ... per ton.	£5 2s. to £5 2s. 6d.	...
l ,, Wire, galv. No. 8, P.O. qual. ,,	£35	...
g Lead, English Pig ... ... ,,	£30 15s.	47/- dec.
g Mercury ... ... per bot.	£13 10s.	5/- to 10/- dec.
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/3½	...
p ,, ,, drawn bars & rods ,,	1/4	...
p ,, ,, rolled strip & sheet ,,	1/3½	...
p ,, ,, wire ... ... ,,	1/3½	½d. dec.
o Platinum ... ... per oz.	£25	...
d Silicium Bronze Wire ... ... per lb.	1/0½	...
r Steel, Magnet, in bars ... ... ,,	10d.	...
n Tin, Block (English) ... ... per ton.	£223 10s. to £227	£5 - £5 5s. dec.
a ,, Wire, Nos. 1 to 16 ... ... per lb.	3/11	3d. dec.

*For 1 cwt. lots. Special quotations against definite specifications.
Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

A Diesel-electric Lightship.—The Dutch motor lightship *Maas*, which was placed in commission last August, and has since proved a very satisfactory craft, represents something of a pioneer vessel. It was desired to render the boat self-propelling in case of necessity, but instead of coupling Diesel engines direct to propellers, the electric drive was adopted so that the generating engines could be utilised for other purposes.

There are two Diesel motors installed in the main engine-room, each a 75-h.p. six-cylinder Polar high-speed set running at 550 r.p.m. and direct-coupled to an 80-volt generator. When they are utilised for propulsion, the power is taken through two electric motors coupled together and driving the propeller shaft, these motors being located in an after engine-room. It is found advantageous in rough weather to keep the motors turning at low speed to reduce the strain on the anchor.

A considerable amount of compressed air is required for the fog horn when it has to operate continuously and there are two low-pressure air compressors, each driven by a 10-h.p. electric motor. The electricity is provided by the main generating plant. Power for the light is obtained from a Brons motor of 15 h.p., driving a dynamo, whilst there is an emergency electrically-driven air compressor of the high-pressure type for the supply of starting or injection air for the main engines. There is, further, a small air compressor, also electrically driven, which is only started up in case of a fog. In such instances it is important that the fog horn should immediately be put into operation, drawing air from the low-pressure air reservoirs. It is possible that the pressure might fall to a point where the horn would not operate satisfactorily before the Diesel engines and main compressors could be started, hence the need for the small set. All the auxiliaries on the vessel are electrically operated and no steam is provided. On trials, a speed of 6¼ knots was attained.—*The Motor Ship.*

Boiler-Room Practice.

Furnace Efficiency, Excess Air, and the Critical Point of Combustion.

By JOHN BRUCE, A.M.I.E.E.

(*Concluded from p. 738.*)

The various values of weight of products of combustion, excess air, and percentage volume of CO_2 are shown plotted in figs. 1, 2 and 3, and a reference to these curves will show, perhaps more readily than the tabulated statements, that (1) the CO_2 indicator or recorder in ordinary everyday practice supplies information concerning air conditions, sufficiently accurate for all ordinary purposes involving a knowledge of excess air percentages; and (2) the curves also show the futility of attempting to express flue gas losses on a basis of CO_2 alone. Flue gas losses and air quantities involved in combustion can only be determined from a knowledge of the ultimate analysis of the coal and an analysis of the residual gases of combustion of that coal.

It has been stated that the criterion of efficient combustion will be found in the relation between the amount of air theoretically required and the amount of air actually supplied for the process of combustion.

The ordinary CO_2 indicator or recorder, while giving fairly reliable information concerning air conditions, is, however, a rather uncertain guide to the overall efficiency of the plant. While a high CO_2 indication certainly means a decreased excess air loss, other factors require consideration. Depending upon the quality of coal and the efficiency of the furnace and combustion chamber air mixing arrangements, a point will be found, corresponding to some definite percentage of CO_2, beyond which any reduction in the air supply results in increased combustion losses which may more than offset any gain due to decreased excess air loss. This point of minimum excess air percentage represents the critical point of combustion. The conditions governing furnace operation are such that none of the losses which occur can be greatly reduced without increasing some other loss, and as the percentage of excess air is reduced, a point is reached where CO and unburned gases appear. No definite percentage of CO_2 can be stated as representing the critical point of combustion. Under the best mechanical stoker conditions, however, it will be in the neighbourhood of 14.00 to 15.00 per cent. CO_2, which corresponds to from 40.00 to 35.00 per cent. of excess air.

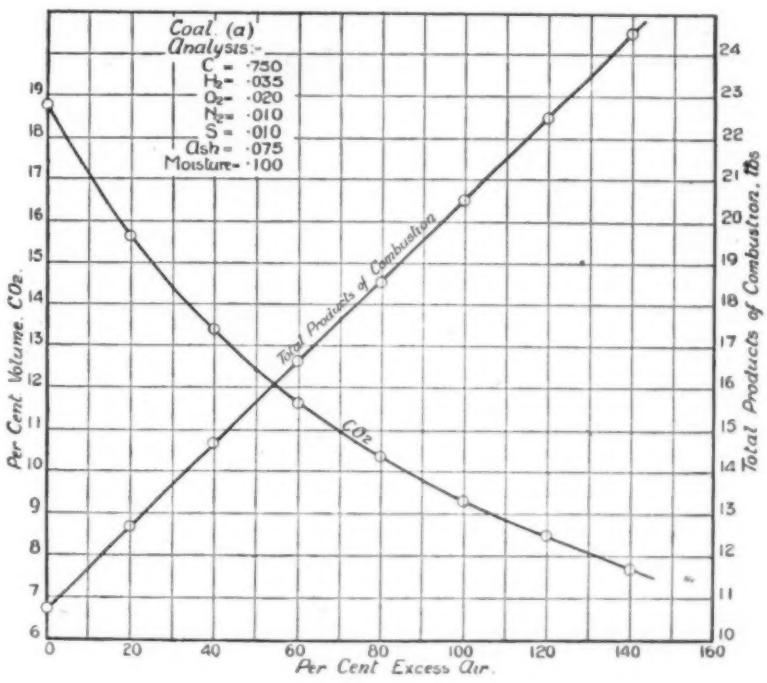


Fig. 1.

From the foregoing it is seen that if the furnace operators are to maintain the air conditions as close to the theoretical as possible, they must have means, in the form of automatic gas analysing apparatus, which will indicate the present of CO and other combustible gases in addition to the usual registration of CO_2.

It was pointed out in a previous article on boiler-room practice that the loss due to excess air consists of two components of the total loss in the dry flue gases, this latter loss being made up of:—

(1) The loss due to heat carried away by the products of theoretical combustion of the actual coal.

(2) The loss due to excess air drawn through the fire bed.

(3) The loss due to the excess air from leakages and infiltration through the furnace and boiler setting.

Item 1, of course, cannot be reduced, and will have a definite value depending upon the theoretical air requirements of the actual coal consumed. Considering item 2, for efficient combustion it is necessary that there be a proper supply and distribution of air throughout the fire-bed, and the fire-bed itself must be in a condition and at a temperature such as will ensure the volatilisation and ignition of the gaseous constituents of the coal after proper mixture with the air. From the behaviour and length of flame and the general condition of the fire-bed, it is possible, even without gas analysing apparatus, to estimate the air conditions existing, and to judge whether there is an excess or a deficiency of air supply. With the older types of chain or travelling grate stokers, it may be found difficult with certain qualities of coal to run a square fire up to the clinker dam, the tendency being for the fire to burn out more rapidly towards the sides. Thickening the fuel bed only results in unconsumed fuel being carried over in the ash, and possibly all different combinations of air supply and fire bed thickness will make no improvement. At the best a compromise has to be effected between the loss due to unburned fuel and the loss due to excess air through the burned out fire bed on the grate. In the later designs of automatic stoker plant, however, it is possible, due to the compartmenting of the stoker and the sectionalising of the guillotine door, to run a square fire up to the clinker dams, no matter what class of coal is being used.

The excess air through the fire bed can also be determined by the usual methods of volumetric gas analysis, provided the sample of gas drawn to the instrument includes no air due to infiltration through sources in the setting between the furnace and the point in the gas pass from which the sample is drawn. Preferably, determinations should be made for CO_2, O_2, and CO. The condition of the fire bed and the relation between the

rate of combustion and air supply can be readily determined by the comparative indications of manometers. Where forced draught is used or air ducts provided beneath the grates, a pitot tube can be employed for the measurement of furnace air supply. If the setting of the furnace necessitates more than one air duct, a pitot tube can be inserted in each air supply passage, and the manometers, which should be of the inclined leg type, can then be mounted on a gauge board in the firing aisle. Under normal conditions, say, with the same fire bed thickness on each grate, the levels of the liquid in the gauges will all be equal, but immediately changes occur in the condition of the fire bed or the amount of air supplied, a marked difference takes place in the levels of the gauge liquids.

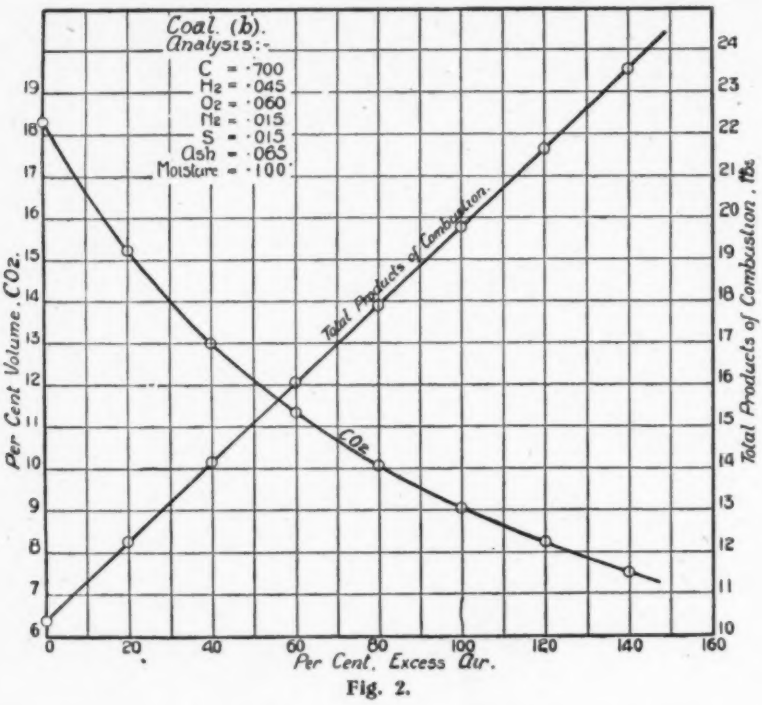


Fig. 2.

Another method of detecting air leakage through holes or thin parts in the fuel bed is by means of a differential draught pressure gauge, arranged to indicate the drop in pressure across the fire bed.

The gauge, or gauges, can be mounted at the front of the boiler. Where a boiler is equipped with more than one grate, a separate differential draught gauge is necessary for each grate. Differential gauges, which show pressure drop through the fuel bed, can be put to very advantageous use in the control of furnace air supply if used in conjunction with the pilot tube manometers. The deflections of the latter increase as the square of the air velocities, while the pressure drop through the fuel bed also varies as the square of the air velocity, therefore there exists a direct relation between the manometer deflections and the differential gauge indications. Certain combustion meters, as distinct from gas analysing apparatus, are based on the principles just outlined. Such instruments either indicate or record on a chart the relative rate of flow of air for combustion of the coal being consumed and the rate of flow of steam produced; it being assumed, when establishing the relations between the amount of steam produced and the amount of air utilised for combustion, that the B.th.u. produced per pound of air utilised in practically the same for all the classes or qualities of coal consumed.

The loss due to air leakage through the furnace and boiler-unit setting can be determined by gas analysis made at different points in the gas passage. If the percentage of excess air leaking through the setting is the only information desired, this can be arrived at, provided combustion is fairly complete, by making determinations for CO_2 only. If, however, the actual loss, expressed either in B.th.u. or as a percentage of the coal consumed, is the information desired, since the weight of gases per pound of coal burned has to be taken into consideration, this loss can only be computed provided an ultimate analysis of the coal is fired and an analysis of the escaping flue gases are available. The actual sources of such loss can be easily detected, provided the engineers in charge of the boiler plant will give the necessary time and trouble to carry out the investigations. While the adoption of the steel casing around the boiler unit, insulated to reduce "radiation" losses, has certainly reduced to a very small value the loss due to air leakage through the setting, many plants are yet erected equipped with the ordinary brick setting. In these plants the deterioration of the already leaky settings has a large bearing on the gradual reduction in operating efficiency. Short circuiting of the gases, due to leaky baffling is another source of loss, permitting the gases to pass directly to the stack without coming into contact with the boiler-heating surfaces. Baffle leaks can be detected by referring draught and temperature readings throughout the unit to standard operating conditions.

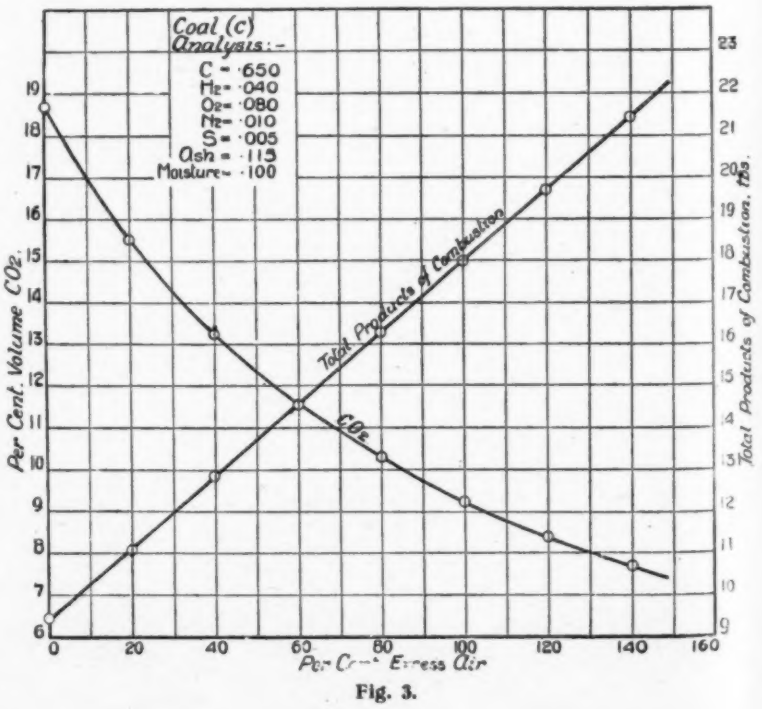


Fig. 3.

The infiltration of air through the furnace and combustion chamber setting provides an excess supply of air that may seriously interfere with the combustion or the gases. The detection of leaks in boiler settings is not a

difficult matter, and leaks in the external setting can always be detected by careful observation. Where a boiler unit has been out for overhaul or inspection, a thorough examination should be made from *inside* the setting for air leaks and for broken down baffling before the unit again goes into service. Briefly, the test is carried out in the following manner:—The grates are run in carrying a bed of coal approximately of the same thickness as would be carried in practice. When the inspecting engineer has entered the setting with an open-flame lamp or torch, the doors are closed and draught conditions adjusted to the average operating conditions. The open flame of the lamp or torch is then exposed to all sources of suspected infiltration and air leaks that would be impossible to locate from outside the boiler are readily discovered in this manner. Particular attention should be given to the junctions between metal and brickwork and the joints of the component parts of the furnace and stoker front. Air leaks can also be located while the unit is in operation by suddenly closing the damper, thus causing smoke to be emitted from all open cracks, joints, and settings, &c.

There are various boiler brickwork coatings manufactured that more or less prevent leakage through faulty brickwork, &c., the essential of such coatings being that they remain in a semi-plastic state and do not dry hard, so that should cracking or loosening of the brickwork take place, the plastic coating retains its continuity and prevents the infiltration of air. Plastic furnace and combustion chamber linings and baffling, moulded while in a plastic condition, are further aids towards decreasing the fuel losses due to air leakage. Brickwork settings, in fact any type of boiler setting, can only be maintained in perfect condition by minute attention to detail, and if the prodigal waste of coal, due to faulty boiler and furnace settings, is to be reduced and maintained at a minimum, a systematic method of inspection and overhaul must be instituted and strictly adhered to.

Swiss Trade Statistics.

THE following statistics, showing the import and export trade of Switzerland in electrical and allied goods, have been taken from the recently-issued official trade returns. The figures for 1922 have also been given, and notes added of any increases or decreases. The returns show the most important but not all the countries of origin or destination of the goods. An asterisk has been placed where the absence of a figure means not necessarily that there has been no trade but that it has been of comparatively slight importance in the year indicated; in such cases, therefore, the precise increase or decrease cannot be given.

IMPORTS.

	1922. Fr.	1923. Fr.	Inc. or dec. Fr.
Electric cable, not insulated.—			
Total	25,000	42,000	+ 17,000
From Germany	15,000	28,000	+ 13,000
„ France	4,000	6,000	+ 2,000
„ United States ...	3,000	*	*
Electric cable not lead covered or iron armoured, insulated wire.—			
Total	347,000	146,000	− 201,000
From Germany	200,000	28,000	− 172,000
„ United Kingdom ...	103,000	*	*
„ France	6,000	11,000	+ 5,000
„ Italy	3,000	5,000	+ 2,000
„ Belgium	*	73,000	*
„ Holland	*	28,000	*
Cable covered with lead.—			
Total	13,000	37,000	+ 24,000
From Germany	6,000	2,000	− 4,000
„ Italy	4,000	6,000	+ 2,000
Cable covered with lead and iron armoured.—			
Total	430,000	34,000	− 396,000
From Germany	214,000	30,000	− 184,000
„ Italy	1,000	*	*
„ United Kingdom ...	142,000	*	*
„ France	73,000	3,000	− 70,000
Cable insulated with rubber or paper and covered with textiles.—			
Total	231,000	311,000	+ 80,000
From Germany	93,000	40,000	− 53,000
„ Italy	7,000	20,000	+ 13,000
„ France	3,000	27,000	+ 24,000
„ Belgium	127,000	179,000	+ 52,000
„ Holland	*	36,000	*
Cable ditto covered with lead.—			
Total	475,000	228,000	− 247,000
From Germany	21,000	39,000	+ 18,000
„ Belgium	43,000	30,000	− 13,000
„ Italy	407,000	133,000	− 274,000
Dynamo-electric machines and electric transformers.—			
Total	1,551,000	1,615,000	+ 64,000
From Germany	898,000	1,089,000	+ 191,000
„ France	66,000	101,000	+ 35,000
„ Italy	8,000	11,000	+ 3,000
„ United Kingdom ...	105,000	364,000	+ 259,000
„ United States ...	411,000	33,000	− 378,000
Accumulators, batteries, electrodes in combination with rubber or celluloid.—			
Total	745,000	979,000	+ 234,000
From Germany	373,000	479,000	+ 106,000
„ Italy	21,000	70,000	+ 49,000
„ France	144,000	206,000	+ 62,000
„ United States ...	27,000	42,000	+ 15,000
„ Austria	128,000	100,000	− 28,000
„ United Kingdom ...	36,000	37,000	+ 1,000
Accumulators, &c. (other).—			
Total	101,000	94,000	− 7,000
From Germany	55,000	56,000	+ 1,000
„ France	31,000	22,000	− 9,000
Electric locomotives.—			
Total	7,000	170,000†	+ 163,000
Steam engines, cranes, pumps, turbines, &c.—			
Total	412,000	403,000	− 9,000
From Germany	282,000	339,000	+ 57,000
„ United Kingdom ...	44,000	*	*
„ Austria	—	3,000	+ 3,000
„ France	4,000	11,000	+ 7,000
„ United States ...	81,000	*	*
Electric arc lamps.—			
Total	18,000	71,000	+ 53,000
From Germany	17,000	70,000	+ 53,000
Electric incandescent lamps, unmounted.—			
Total	500	—	− 500
From Germany	500	—	− 500
Electric incandescent lamps, mounted.—			
Total	1,638,000	2,066,000	+ 428,000
From Germany	586,000	339,000	− 247,000
„ Austria	257,000	118,000	− 139,000
„ Holland	693,000	1,480,000	+ 787,000
„ United Kingdom ...	13,000	—	− 13,000
„ France	40,000	35,000	− 5,000
„ Hungary	38,000	*	*
Insulators, mounted.—			
Total	364,000	91,000	− 273,000
From Germany	68,000	67,000	− 1,000
„ United Kingdom ...	4,000	*	*
„ United States ...	253,000	*	*
„ Canada	35,000	*	*
Electric meters.—			
Total	366,000	297,000	− 69,000
From Germany	331,000	258,000	− 73,000
„ France	17,000	23,000	+ 6,000
„ United Kingdom ...	7,000	*	*
Telegraph and telephone apparatus.—			
Total	3,094,000	2,373,000	− 721,000
From Germany	1,800,000	786,000	−1,014,000
„ United Kingdom ...	285,000	200,000	− 85,000
„ Sweden	4,000	45,000	+ 41,000
„ France	55,000	257,000	+ 202,000
„ Belgium	938,000	1,072,000	+ 134,000

	1922. Fr.	1923. Fr.	Inc. or dec. Fr.
Electrical apparatus not elsewhere mentioned.—			
Total	1,379,000	1,670,000	+ 291,000
From Germany	896,000	1,018,000	+ 122,000
,, France	53,000	113,000	+ 60,000
,, United Kingdom ...	130,000	476,000	+ 346,000
,, United States ...	120,000	38,000	− 82,000

EXPORTS.

	1922. Fr.	1923. Fr.	Inc. or dec. Fr.
Dynamo-electric machines and electric transformers of all kinds.—			
Total	24,986,000	22,548,000	−2,438,000
To Germany	432,000	239,000	− 193,000
,, Austria	162,000	93,000	− 69,000
,, France	6,084,000	2,996,000	−3,088,000
,, Italy	966,000	846,000	− 120,000
,, Belgium	1,657,000	1,427,000	− 230,000
,, United Kingdom ...	1,472,000	1,552,000	+ 80,000
,, Egypt	755,000	492,000	− 263,000
,, Spain	3,796,000	4,740,000	+ 944,000
,, British India	1,033,000	58,000	− 975,000
,, Poland	486,000	485,000	− 1,000
,, Rumania	535,000	476,000	− 59,000
,, Colombia	629,000	259,000	− 370,000
,, Brazil	716,000	490,000	− 226,000
,, Argentina	412,000	900,000	+ 488,000
,, Netherlands	811,000	719,000	− 92,000
,, Norway	918,000	1,136,000	+ 218,000
,, Netherlands Indies ...	204,000	214,000	+ 10,000
,, China	375,000	669,000	+ 294,000
,, Japan	1,552,000	2,170,000	+ 618,000
,, Peru	*	495,000	*
Accumulator batteries, electrodes in combination with rubber or celluloid.—			
Total	34,000	125,000	+ 91,000
To France	4,000	2,000	− 2,000
,, Italy	4,000	3,000	− 1,000
,, United Kingdom ...	15,000	44,000	+ 29,000
,, Spain	2,000	*	*
,, Greece	3,000	*	*
,, Egypt	4,000	*	*
,, United States	3,000	*	*
,, Poland	*	59,000	*
Cable not lead covered or iron armoured, Insulated wire.—			
Total	839,000	1,157,000	+ 318,000
To France	64,000	86,000	+ 22,000
,, United Kingdom ...	474,000	837,000	+ 363,000
,, Czecho-Slovakia ...	32,000	*	*
,, Austria	28,000	15,000	− 13,000
,, India	94,000	79,000	− 15,000
,, Rumania	73,000	*	*
,, Egypt	*	20,000	*
Accumulators, &c. (other).—			
Total	158,000	74,000	− 84,000
To France	7,000	32,000	+ 25,000
,, Italy	—	11,000	+ 11,000
,, Spain	2,000	*	*
,, Rumania	140,000	*	*
Insulators, mounted.—			
Total	304,000	250,000	− 54,000
To Germany	24,000	39,000	+ 15,000
,, France	91,000	46,000	− 45,000
,, Holland	7,000	*	*
,, Italy	35,000	85,000	+ 50,000
,, Sweden	21,000	*	*
,, Spain	51,000	*	*
,, United Kingdom ...	58,000	55,000	− 3,000
Electric cable not insulated.—			
Total	96,000	1,189,000	+1,093,000
To France	41,000	270,000	+ 229,000
,, Belgium	5,000	*	*
,, Spain	1,000	*	*
,, United Kingdom ...	26,000	471,000	+ 445,000
,, Rumania	14,000	*	*
,, Serbia	*	398,000	*
Cable, lead covered.—			
Total	233,000	101,000	− 132,000
To Greece	*	52,000	*
,, Rumania	227,000	*	*
Cable, lead-covered and iron armoured.—			
Total	518,000	321,000	− 197,000
To Rumania	494,000	196,000	− 298,000
,, Brazil	10,000	*	*
,, Serbia	*	36,000	*
,, Argentina	*	48,000	*
Cable, insulated with rubber or paper and covered with textiles.—			
Total	12,000	50,000	+ 38,000
To France	10,000	41,000	+ 31,000
Electric locomotives.—			
Total	32,000	1,082,000	+1,050,000
To Sweden	15,000	*	*
,, United Kingdom ...	—	188,000	*
,, Holland	12,000	*	*
,, Spain	—	235,000	+ 235,000
,, Japan	—	643,000	+ 643,000
Telegraph and telephone apparatus.—			
Total	1,667,000	175,000	−1,492,000
To France	13,000	29,000	+ 16,000
,, Italy	20,000	4,000	− 16,000
,, Holland	3,000	*	*
,, Spain	1,000	*	*
,, Belgium	18,000	—	− 18,000
,, Rumania	1,589,000	*	*
,, Greece	*	74,000	*
,, United Kingdom ...	*	25,000	*
Electric incandescent lamps, unmounted.—			
Total	1,000	—	− 1,000
To France	1,000	—	− 1,000
Electric incandescent lamps, mounted.—			
Total	3,868,000	3,508,000	− 360,000
To Austria	51,000	10,000	− 41,000
,, France	845,000	850,000	+ 5,000
,, Italy	1,792,000	1,928,000	+ 136,000
,, Portugal	74,000	48,000	− 26,000
,, Spain	22,000	*	*
,, Greece	25,000	*	*
,, Norway	229,000	261,000	+ 32,000
,, Rumania	91,000	*	*
,, Algeria	102,000	61,000	− 41,000
,, Canada	140,000	80,000	− 60,000
,, Australia	88,000	40,000	− 48,000
,, Czecho-Slovakia ...	126,000	*	*
,, British India	8,000	*	*
,, United Kingdom ...	76,000	69,000	− 7,000
,, Egypt	18,000	*	*
Electric meters.—			
Total	8,067,000	10,280,000	+2,213,000
To Germany	28,000	22,000	− 6,000
,, Austria	18,000	119,000	+ 101,000
,, France	2,043,000	2,711,000	+ 668,000
,, Italy	608,000	652,000	+ 44,000
,, United Kingdom ...	687,000	727,000	+ 40,000
,, Belgium	1,236,000	1,157,000	− 79,000
,, Spain	594,000	751,000	+ 157,000
,, Japan	897,000	1,560,000	+ 663,000
,, Netherlands	341,000	153,000	− 188,000
,, Czecho-Slovakia ...	668,000	616,000	− 52,000
,, Australia	378,000	837,000	+ 459,000
Steam engines, cranes, pumps, turbines, &c.—			
Total	16,829,000	14,226,000	−2,603,000
To Germany	311,000	371,000	+ 60,000
,, France	3,144,000	1,941,000	−1,203,000
,, Belgium	2,956,000	2,167,000	− 789,000
,, Holland	1,281,000	375,000	− 906,000
,, British India	4,000	46,000	+ 42,000
,, Japan	1,581,000	2,395,000	+ 814,000
,, United Kingdom ...	2,922,000	1,647,000	−1,275,000
,, Spain	197,000	1,151,000	+ 954,000
,, China	284,000	899,000	+ 615,000
,, Argentina	1,200,000	1,119,000	− 81,000
,, Egypt	247,000	422,000	+ 175,000
,, Rumania	130,000	191,000	+ 61,000
,, Russia	383,000	681,000	+ 298,000
,, Portugal	291,000	*	*
,, Colombia, Chile, &c.	207,000	75,000	+ 132,000
Electrical apparatus not elsewhere mentioned.—			
Total	9,421,000	9,104,000	− 317,000
To Germany	284,000	99,000	− 185,000
,, Austria	40,000	98,000	+ 58,000
,, France	2,642,000	2,096,000	− 546,000
,, Italy	486,000	423,000	− 63,000
,, Belgium	1,551,000	1,998,000	+ 447,000
,, Netherlands	345,000	309,000	− 36,000
,, United Kingdom ...	731,000	686,000	− 45,000
,, Spain	1,168,000	1,242,000	+ 74,000
,, Portugal	166,000	126,000	− 40,000
,, Norway	189,000	132,000	− 57,000
,, Czecho-Slovakia ...	41,000	229,000	+ 188,000
,, Egypt	243,000	177,000	− 66,000
,, China	56,000	170,000	+ 114,000
,, Japan	309,000	164,000	− 145,000
,, United States	48,000	251,000	+ 203,000
,, Argentina	87,000	119,000	+ 32,000
,, Peru	*	98,000	+ *

* Not specified.
† All from Germany.

Some of the Exhibits at Wembley.

Messrs. G. & J. Weir, Ltd.

(*Stand No.* 44, *Avenues* 5 *and* 6, *Bays* 12-15.)

Plant for dealing with boiler feed water is shown on this stand. A direct-contact feed-water heater and de-aerator is exhibited. In this the feed water is delivered to the heater by either a main engine-driven pump or an independent pump, where it comes into contact with and condenses the auxiliary exhaust steam which raises its temperature. The air and dissolved gases are liberated and drawn off, while the automatic regulation of the feed pumps by the control gear in the heater enables the water to be delivered to the boiler in an entirely non-corrosive state.

Examples of the "Weir" direct-acting boiler feed pump are shown. The latest improvements include newly-designed water-valves, seats, and fittings, and Monel metal is employed. Another exhibit is an evaporator fitted with an automatic feed regulator and brine ejector, which maintains a constant density in the shell.

The "Paragon" air pump shown is specially designed for steam turbine installations with high vacua. The combination consists of a reciprocating water-extraction pump to deal with the condensate, and a steam jet air ejector to deal with the air and non-condensible vapours. The condensate is discharged by the pump through a heater condenser where the steam is condensed, heating the feed water, the drain and air being passed to the air pump. There is also a multi-flow feed water heater. This is of the surface type. The tubes are of copper, expanded into cast-iron headers, which are free to expand, thus eliminating all leakage trouble. The water velocity and surface distribution are so arranged as to give the maximum heat transfer. Other exhibits are boiler feed pumps, a multi-jet nozzle heater, a locomotive feed pump, oil pumps, an air compressor, a corrosion detector, and a hydrokineter which ensures rapid circulation of the water in boilers, preventing unequal expansion.

The Quasi-Arc Co., Ltd.

(*Stand No.* 44, *Avenue* 10*a*, *Bay* 25.)

A number of samples of its welded work are shown by the company. Among these is a full-size model of a portion of a rivetless ship, wholly welded by the "Quasi-Arc" process. A conveniently-designed portable welding set, developing 5 kW (200 A), is shown (fig. 54). This consists of a welding dynamo of special design driven by a petrol engine. Apart from the current regulator, which is placed close to the operator's hand, the whole forms a self-contained unit. The regulator for this

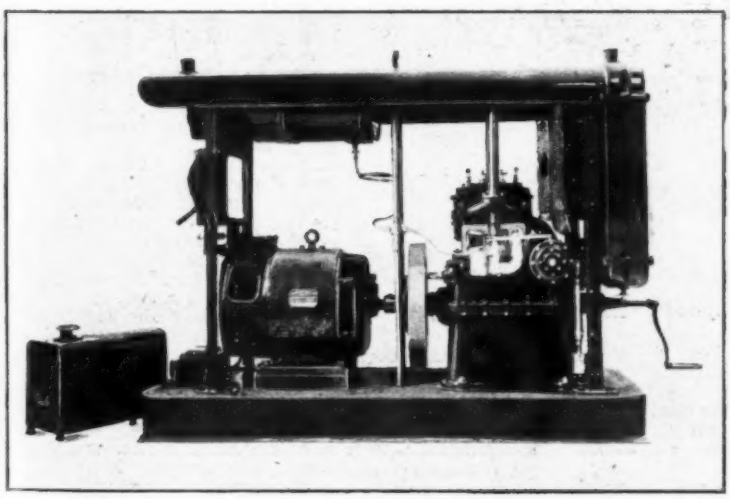


Fig. 54.—The "Quasi-Arc" Portable Welding Plant.

plant, and other types of regulator, are on view. For the rest the exhibit consists of samples of special electrodes, and photo-micrographs of welds showing the perfect crystalline diffusion between the added metal and that of the original piece.

The Horstmann Gear Co., Ltd.

(*Palace of Industry, Stand No.* 157, *Section D.*)

On this stand the company shows time switches of various patterns. The simplest type exhibited consists of the adaptation of an 8-day clock movement to operate the dolly of an ordinary tumbler switch, the action being provided by the alarm attachment. For shop-window lighting the firm shows a clock movement with the necessary switch tappets provided with a two-pin plug which can be inserted in a socket in the lighting circuit. If desired the "on" tappet can be hinged so as to permit it to be snapped back over the dial to prevent the switch acting on any particular day. Dials with "equation" devices to automatically adjust the time of lighting and extinguishing to correspond with the variation in the time of sunrise and sunset are also shown. Special 15-day switches for street-lighting are another feature of the stand, many of these being fitted with substantial weatherproof

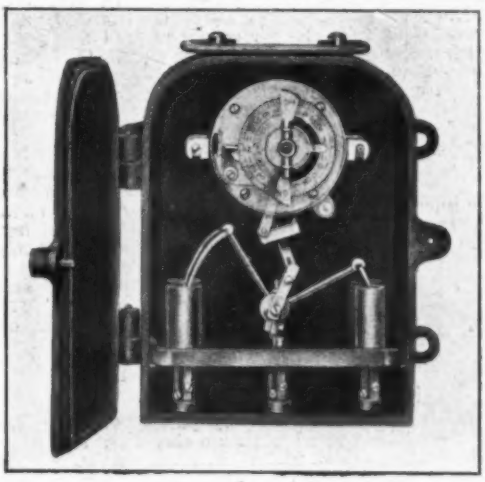


Fig. 55.—A Horstmann Two-way Time Switch.

cases. The switch illustrated in fig. 55 has a 35-day movement, and it can be used on circuits where a low rate is charged for consumption during certain hours, as it has a change-over, two-way arrangement. The contacts are copper in mercury, the latter being in unspillable cups fitted to a slate base. This base slides out to render the cups available for inspection. A cast-iron case with screw lock is fitted.

Prince's Electrical Clocks, Ltd.

(*Palace of Industry, Stand No.* L405.)

The "Princeps" electrical clock shown on this stand employs a pendulum which has no mechanical connection whatever with the movement; it merely touches two exceedingly light springs, thereby completing circuits which operate an electrical device which performs the work. The actual sustaining of the pendulum, that is to say, the maintenance of its amplitude, is contrived in a very ingenious manner by means of one of the side contact springs. Thus the time-keeping of the clock is not affected or interfered with by the movement, and does not depend upon the strength of the current. The electrical mechanism mentioned above, which is known as the "Reverser," consists of two cores, having light poles at their lower end, pivoted between which is a steel armature. Each core carries a winding, and the winding on each core is in circuit with the side contacts, so that as the pendulum swings it completes the circuit through each in turn. The effect of this is to neutralise the magnetism in the cores upon either side alternatively, so that the magnet which is not neutralised attracts its side of the armature. This movement of the armature is used to depress the small side contact springs and also to break the circuit. The electrical impulses passed through the windings are used to actuate the movement of a separate clock, and by means of suitable relays will also operate any number of "slave" dials.

The clock is the invention of Major C. E. Prince, O.B.E., M.I.E.E., of Marconi's Wireless Telegraph Co., Ltd.

The British Mannesmann Tube Co., Ltd.

(*Stand No.* 64, *Avenues* 5 *and* 6, *Bays* 26-28.)

This exhibit comprises weldless and lap-welded tubes for all purposes. Included among these are examples of hydraulic power line fittings suitable for hydro-electric undertakings; these are a forged steel oval flange hydraulic joint, and a riveted joint for a pipe line of 42-in. bore and 1¼ in. thick. Weldless steel boiler and stay tubes are exhibited swelled one end, staved one end and reduced the other, staved and screwed, and also fitted with copper sleeves. High tensile

steel poles are another exhibit. These are made in one complete stepped length, without joints. Kay towers for telegraph and power lines are also shown. Steam pipe details, spigot and faucet tubes for underground installations, ships' equipment, and weldless steel cylinders are among the other exhibits of the company.

Messrs. George Kent, Ltd.

(*Stand No.* 79, *Avenues* 11 *and* 12, *Bays* 22 *and* 23.)

Messrs. Kent show a comprehensive range of measuring apparatus for use in boiler houses, &c. Three different types of steam-flow recorders are displayed, namely, the "diagram only" instrument, without pressure-correction device, a similar instrument with pressure correction, and a counter and diagram recorder with pressure correction. The "Kent" boiler-load indicator is also shown, this apparatus being particularly suitable for individual boiler control. These instruments are operated on the differential principle, orifice fittings being provided in the steam main for the purpose. Orifice fittings of different types are shown. The air meters comprise a diagram recorder in conjunction with its orifice fitting, and a counter recorder of the shunt type, which is of the rotary turbine pattern, bolted directly in the air main. There are also two gate-type air meters for indicating the flow in mains up to 1¼ in. and 2½ in. diameter respectively. A coal meter operated on the helical screw principle, manometers, planimeters, and gas-recording instruments are also on view at the stand. In addition to this exhibit the company shows water meters at another stand, and its instruments are in use in many parts of the Exhibition.

The Variable Speed Gear, Ltd.

(*Stand No.* 1, *Avenue* 7, *Bays* 7 *and* 8.)

A number of variable delivery pumps and examples of hydraulic variable speed gears are shown by this company. One interesting exhibit is that illustrated in fig. 56. This is a working model of the four-ram type electro-hydraulic steering gear operated by a Williams-Janney variable delivery pump. The variable-speed gear consists of two similar hydraulic units, each of which comprises a group of cylinders mounted upon a shaft revolving in a fixed casing, one unit fulfilling the function of a pump and supplying fluid to the other, which acts as a motor. The pump is driven at constant speed, in one direction, from the source of power, and means are provided whereby the stroke of its pistons may be varied, with the consequent result that the rate at which the fluid is

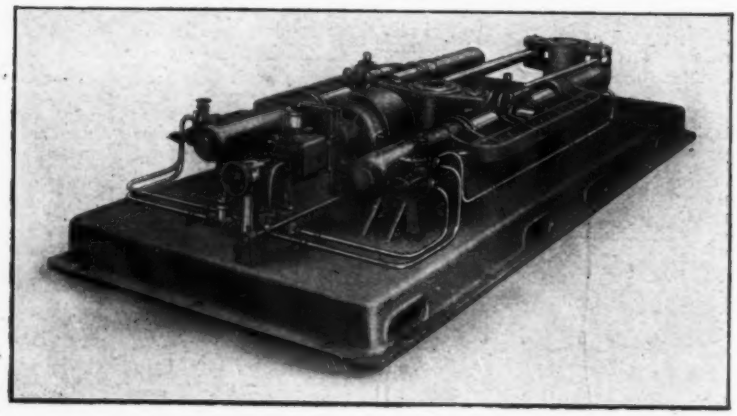


Fig. 56.—Williams-Janney Electro-hydraulic Steering Gear.

delivered may be adjusted from zero to the full capacity of the pump. The motor unit, however, has a fixed stroke, and its speed therefore depends upon the quantity of fluid delivered by the pump. Thus by suitably controlling the stroke of the pump the motor may be caused to rotate at any speed from that of the pump to zero. The stroke-controlling mechanism on the pump is further arranged to alter the relative positions of the pistons, and consequently to reverse the direction of flow of the fluid, with the result that the motor can be run in the backward direction with the same range of speeds. The prime mover is a shunt-wound d.c. or a squirrel-cage a.c. motor, and the only connections between the engine room and the steering gear compartment are the cables carrying current to the motor, and these can be laid without interfering with cabin or cargo space.

Fuller's United Electric Works, Ltd.

(*Stand No.* 117, *Avenue* 14, *Bays* 10 *and* 11.)

The exhibit of this company consists chiefly of accumulators and dry cells, cables, insulating materials, and radio apparatus. Among the dry cells are examples of inert cells and batteries for radio purposes, lamps, signalling, &c. The accumulators include typical house-lighting batteries, automobile starting and lighting batteries ("Sparta" type), accumulators for the heating of thermionic valve filaments, a battery for a submarine, in an ebonite container, showing the plates, &c., in section, and train lighting batteries. The radio apparatus shown comprises loud speakers, tone selectors, inter-valve and telephone transformers, potentiometers, filament resistances, condensers, &c. Miners' lamps and components are displayed, as well as mine signalling batteries. Cables of many types are shown, including an aluminium and brass armoured cable for automobile connections. A number of ebonite mouldings for electrical purposes complete the exhibit.

Messrs. S. G. Brown, Ltd.

(*Stand No.* 113, *Avenue* 14, *Bays* 6 *and* 7.)

This company exhibits a selection of its well-known radio-telephone accessories, including telephones, loud speakers, microphone amplifiers, and (in conjunction with the Telegraph Condenser Co., Ltd.), electrical condensers. The "Crystavox," a loud speaker which will work off a crystal receiving set, if it is used within about ten miles from a broadcasting station, is among this apparatus. Another exhibit is the gyro-compass, which has the advantage of being independent of the earth's magnetism, the influence of which is subject to many, sometimes erratic, changes. The gyro-compass consists of an electrically-driven wheel, rotating at a very high speed, mounted in gimbal rings and carrying a compass card. The rotation of the earth gives the wheel north-seeking properties. This master wheel is placed in a convenient part of the ship, together with its auxiliary electrical apparatus and switchgear, and from it any number of repeater compasses can be driven. The wheel of the master compass weighs 4¼ lb. and rotates at a speed of 14,000 r.p.m. In order to guard it against any possible disturbance due to the motion of the ship, the gyro-wheel in its casing is carried upon knife edges in a vertical ring. This ring, in turn, carrying the compass card, is supported upon a patented hydraulic bearing which, in effect, floats the sensitive gyro element upon an oscillating column of oil. Special correction and steering repeaters can be provided. Another appliance for use on board ships (although its usefulness is not confined to this particular application) is the electro-megaphone. This is a telephone by means of which it is possible to hear ordinary speech at a distance of 60 yards away from it. The instrument operates on the reed-controlled diaphragm principle.

Messrs. Hick, Hargreaves & Co., Ltd.

(*Stand No.* 26, *Avenue* 10, *Bays* 6 *and* 7.)

The principal exhibit on this company's stand is a 325-i.h.p. Uniflow steam engine, running at a normal speed of 180 r.p.m., and designed for working with superheated steam at 180 lb. per sq. in. The distribution of steam is by piston valves controlled by trip gear of simple and robust design in conjunction with a high-speed governor. The valve gear is shown in operation, the lay shaft being driven by an electric motor through reduction gearing. The pump supplying oil under pressure to the main moving parts is also driven from this lay shaft through machine-cut spiral gearing. Another engine shown is a vertical enclosed type 3-cylinder oil engine of the high-compression, airless-injection, cold-starting type, fitted with a complete system of forced lubrication. The continuous normal rating is 120 b.h.p., at 32 r.p.m., and the engine is suitable for the driving of an electric generator. The engine will run on any grade of Diesel-engine oil. A multi-jet condensing plant with a rotary water extraction pump and a Hick-Breguet "Ejectair," for the removal of air and gases, is shown. The principal advantage of the "Ejectair" apparatus is that it dispenses with the usual reciprocating air pump; the only moving parts of the plant are the spindle of the water extraction pump, with its impeller. The "Ejectair" is fitted with a patent stabilising valve which automatically regulates the work of the two ejectors at light loads. This plant is also provided with a water extracting ejector, which is supplied when the rotary extraction pump is driven from the engine or turbine shaft, to prevent the accumulation of water in the condenser. The separate surface condensing plant auxiliaries for a 5,000-kW turbo-generator set, shown separately, comprise an "Ejectair," consisting of primary and secondary ejectors with an auxiliary or intermediate condenser, and fitted with starting valve, steam strainer, stabilising valve, and pressure and vacuum gauges, and a rotary extraction pump which is specially designed to avoid air locks and ensure starting at all times; it is capable of withdrawing the whole of the condensed steam from the main condenser against a maximum vacuum and discharging it against a head of 90 ft. The remainder of the exhibit comprises a bladed disk for a 2,000-b.h.p. high-speed impulse turbine, a double-cylinder barring engine, mill-gearing details, a brass tube plate for a large surface condenser, and a model rotary water strainer.

Messrs. J. Blakeborough & Sons, Ltd.

(*Stand No.* 180, *Avenues* 1 *and* 2, *Bays* 12 *and* 13.)

The exhibit of this company (which is associated with Messrs. George Kent, Ltd.), comprises valves for many purposes. One interesting item is an electrically-operated sluice

valve, 24-in. bore, which is shown in action. An arrangement of ball thrust washers practically eliminates friction on the collar of the valve spindle, and lubricating facilities are embodied. The gear is in an enclosed case and runs in grease or oil. A new form of friction clutch is fitted to provide against failure of the electrical limit switches or damage due to any obstruction in the valve; this has a handwheel which remains stationary when the valve is being electrically operated. An "Edwards" self-closing valve is exhibited. This automatically shuts off water in the event of a burst on the down-stream side. The action takes place quickly but slows down towards the final stages, thus avoiding shock. Automatic exhaust relief valves, which have been specially designed for use with condensing engines and turbines, are shown. The function of these is to protect the condenser as an ordinary safety valve protects the boiler. Other exhibits are sluice valves, reducing valves, oil and steam valves, hydrants and fire appliances, &c.

The City Accumulator Co.

(*Stand No.* 146, *Avenue* 15, *Bay* 12.)

Four types of radio receiving sets are shown by this firm. The "Super-three" is a 3-valve receiver with aerial condenser, anode condenser, and coil tuning. The third valve can be cut in and out at will. The "C.A.C." crystal-valve receiver is a variometer-tuned set with one stage of note amplification. The simple crystal receiver is also shown. A particularly sensitive portable type of four-valve receiver with a frame aerial fitted in the lid is exhibited. This measures only 12 in. by 14 in. by 7¼ in.

The Magnetic Separator Co.

(*Stand No.* 208, *Avenue* 1, *Bay* 22.)

This firm shows its "Cascader" machine for the magnetic separation of ferrous metals. This consists of an inclined plane arranged in steps. The front face of each step is undercut, and in this recess an electromagnet is fitted. The material from which the iron, &c., is to be separated flows down the incline, and all iron particles or pieces are attracted by the magnet to the underside of the steps, where they are held clear of the main flow. When the flow of material is stopped the current is switched off, allowing the iron to fall into a special container. The firm also makes the rotary magnetic pulley type of separator.

Messrs. A. J. Stevens & Co. (1914), Ltd.

(*Stand No.* 116, *Avenue* 14, *Bays* 9 *and* 10.)

Radio receiving sets and accessories are shown by this company. Three- and four-valve sets are fitted with a special H.F. valve switch which permits the use of two or three valves at a time if required. Power amplifiers, loud speakers, and variable condensers are also shown. The "unit" system which is on view embodies a three-part cabinet receiver, each part of which can be purchased separately. The top portion contains a four-valve receiver, the centre part the high- and low-pressure batteries, and the base the loud speaker. Tubular steel telescopic masts—35 or 50 ft. high—are another feature of the display. These can be easily installed without erecting gear of any sort.

Sir W. H. Bailey & Co., Ltd.

(*Shipbuilding, &c., Section, Stand No.* 38, *Avenue* 7, *Bay* 4.)

Included in this exhibit are gauges of various kinds. One of these is a "tell-tale" recording gauge for pressure and vacuum, the principal features of which are a hard solid drawn phosphor-bronze bend, a correctly cut nickel-alloy pinion, an accurately-cut hard-brass quadrant, a heavy cast gunmetal mounting, and a nipple machined from a solid gunmetal casting. The machines shown include a cement-testing machine, boiler test pumps, a dead-weight gauge tester for vacuum and pressure gauges, and recording gyrometers for making a permanent record of the speed of engines and other machinery. The last are provided with a pulley, which is driven by a steel tape belt from the machine concerned.

British Vacuum Cleaner & Engineering Co., Ltd.

(*Stand* 45, *Avenue* 11, *Bay* 25.)

Three types of electrically-driven vacuum cleaners are exhibited by this company. One of these is a positive-type stationary set consisting of a rotary exhauster, belt-driven by a 1.5-h.p. motor. The other two are, respectively, a portable turbine-type machine contained in one casing, with a direct-coupled .75-h.p. series motor, and weighing 140 lb., and a portable cleaner, consisting of a positive rotary air exhauster and a .5-h.p. motor. Fittings, photographs, &c., are shown in connection with the company's pneumatic suction plant for removing and conveying flue dust, ashes, and industrial powders.

Ebonestos Insulators, Ltd.

(*Stand No.* 77, *Avenues* 11 *and* 12, *Bays* 20 *and* 21.)

A great deal of insulating material is shown by this company. Among this is a special moulded terminal block for use in connection with electricity meters. This block contains six metallic inserts, which are moulded into the material, each separated from the others, to serve as connections for various leads. An arc chute moulded in one piece is shown. The rigorous conditions of service which this has to stand may be judged from the fact that it not only has a high interior temperature due to continual arcing, but it has to retain its insulating properties, to be non-hygroscopic and of sufficient mechanical strength to withstand the shocks and jolts to which it is subjected. Chutes of this type have been in service for five years without signs of deterioration. Among the moulded parts for radio work are condenser knobs, telephone earcaps, valve sockets and holders, &c. A number of bakelite mouldings are exhibited. These include distributors,, bobbins, &c. Heat and fireproof articles are represented by arc barriers, electric iron connectors, switches, and lampholders.

Messrs. Ruston & Hornsby, Ltd.

(*Stand No.* 21, *Avenues* 6 *and* 7, *Bays* 23 *and* 24.)

In addition to the 250-kW "Ruston-Crompton" generating set, which is acting as an auxiliary power unit for the Exhibition, and will be described by us in this connection, the company has examples of others of its engines. The largest is a 165-b.h.p. three-cylinder enclosed-type vertical airless injection oil engine. The oil is injected directly into the combustion space by means of separate pumps for each cylinder. No starting lamp is required, as the heat of compression suffices to ignite the fuel charge. The engine will run on the lowest-grade fuel oils. An engine similar in principle, but of the horizontal type (42 b.h.p.), is another exhibit. A "Ruston-Stockport" 60-b.h.p. suction gas engine is shown. This is so designed that all working parts can be readily removed for examination without cumbersome dismantling. The interior of the combustion chamber is of special design, which gives a low fuel consumption. Other exhibits are a 7-b.h.p. petrol-paraffin engine for cold starting; an engine-driven pumping plant; and a model of a 250-b.h.p. refuse gas producer. The last plant is suitable for the treatment of a large range of waste materials.

Simms Motor Units (1920), Ltd.

(*Motor and Cycle Section. Exhibit No.* 6.)

Magnetos for all classes of ignition work are shown by this company. Special features of these machines are the watertight construction (it is claimed that water may be sprayed on to them without harming them); the high resistance of the insulation between the windings and shaft (earth), which is about 100,000 megohms; and the employment of a special non-hygroscopic insulation which does not soften under the heat given off by the engine. The other principal exhibit is a patent flexible coupling for magnetos and dynamos. This coupling consists of two toothed flanges, between which is a hard rubber-like disk. The function of the coupling is to enable accurate timing to be secured. This is effected by a vernier arrangement. One half of the coupling has 20 teeth, while the other has 19, and the two are easily adjusted in relation to one another. By this means a movement of 1/380th of a revolution can be made, and this is shown by graduations on the periphery of the coupling.

Messrs. I. Calvete, Ltd.

(*Stand No.* 127, *Avenue* 15, *Bays* 15 *and* 16.)

One of the principal exhibits of this company is the "Teleswitch" for the remote control of electric lights. It is provided with an independent circuit, energised by dry cells, which is similar to an ordinary bell circuit. Apart from this the exhibit comprises electromedical apparatus in great variety. This includes high-frequency equipment, electric massage vibrators, hot and cold air douches, and therapeutic radiant lamp apparatus.

THE G.E.C. PAVILION OF ELECTRICITY.

On Friday last the General Electric Co., Ltd., London, entertained a large party of representatives of the technical, trade, and lay Press at the British Empire Exhibition. The programme included a tour through the various sections of the "G.E.C. Pavilion of Electricity" in the Palace of Engineering, a display of kinematograph films in the large hall which forms part of the Pavilion, graphically illustrating "The Story of the G.E.C.," and luncheon at the Lucullus restaurant. The Pavilion covers an area of more than 5,000 square feet, and comprises two storeys; within its boundaries there has been brought together undoubtedly the most comprehensive and varied exhibit in the Palace of Engineering—a veritable exhibition in itself—ranging from a 5,000-kW turbo-alternator to a cigar lighter, and covering almost every branch of the industry—almost the only items not included in the manufacturing activities of the company being accumulators. Amongst the more prominent features of the exhibit are the turbo set above mentioned, a rotary converter, high- and low-pressure switchgear, transformers, conveyors, steel works and colliery plant and winding gear, cable, lighting and power apparatus of every description, cooking and heating appliances, wiring, telephones (including a 100-line P.O. c.b. exchange, in operation, and an automatic exchange), fans, lamps, radio valves and sets, single-phase railway motors, railway signalling apparatus, and many other items. As we shall shortly publish an illustrated account of the exhibit, further particulars may be deferred; we have said sufficient to indicate the extraordinary scope of the collection, which is moreover admirably set out, and appeals not only to the technical visitor, but also—and very effectively—to the general public.

After the luncheon Mr. Hugo Hirst, chairman of the company, remarked that the last electrical exhibition took place at Olympia 12 years ago; the present one was on a much higher plane. After the war the economic resources of almost every country were exhausted, and the Government thought it desirable to hold an exhibition to demonstrate the productive capacity of their great Empire. He had given the proposal his whole-hearted support, moved solely by the national interests, for he did not expect any return from it from the business point of view. Unfortunately to the average visitor an engineering exhibition was very cold; no exhibition could show the influence of electrical applications on the conditions under which people lived, and exhibitions did not attract buyers. But such an exhibition revealed the greatness of the country, and might do a great deal of good. They could not show there the gigantic organisation and huge works that stood behind their exhibits; the company employed some 18,000 workers, representing a population of, say, 50,000 persons, whose welfare was a heavy responsibility on the shoulders of the directors. He felt confident with regard to the present and the near future, but had misgivings with regard to the more remote future, unless manufacturers were backed up by Governments, and the removal of the McKenna duties was ominous. They were competing with nations which, unlike the British, did not attempt to improve the workers' lot. There was not a "slump" in the ordinary sense; civilisation had been set back, and they could only regain prosperity by hard work, which could not succeed unless manufacturers were assured of the home market, for foreign countries were not yet in a position to buy. It might raise prices somewhat but would increase wages, and everyone would benefit. The future of the electrical industry was assured; every Government would promote its development. With 40 years' experience in the General Electric Co., he acquired information from all quarters, and he hoped the statesmen and politicians would do the best for the country; old shibboleths must be abandoned, for conditions had been wholly changed by the war. Mr. Hirst concluded by giving the toast of "The Press," and Mr. Sidney Rentell, responding, expressed the thanks of the guests to the company for the demonstration of its exhibits, which enabled them to visualise the ramifications of its great factories. He was an optimist, and believed that great Exhibition would bring a large amount of business to the electrical industry.

In response to a vote of thanks proposed by Mr. Rentell, Mr. Max Railing, director, expressed his pleasure at seeing that large gathering, and said the directors would live up to the great responsibility that was imposed on them. Great developments would take place in the next few years, and times would not be so hard as was imagined.

Mr. G. Basil Barham proposed the health of the Publicity Department of the G.E.C., and Major Palmer acknowledged the compliment, which was greatly appreciated.

The Engineers' Club, (London).

First Annual Dinner.

THE first annual dinner of the Engineers' Club (London) was held at the Connaught Rooms on May 6th. Close upon 400 covers were laid, and members of the Government and many distinguished scientists, engineers, metallurgists, chemists, and architects were invited to the function. In the absence of Sir Joseph W. Isherwood, president of the Club, who had been suddenly called to America, the chair was occupied by Mr. Ben H. Morgan, chairman of the general committee of the Club and of the British Empire Producers' Organisation.

Following the loyal toast, the chairman read a radio message of regret at the president's unavoidable absence, and a suitable reply was dispatched.

SIR T. HARRIS SPENCER, K.B.E., M.I.Mech.E., in proposing "Success to British Engineering," said that many people appeared to want to help the foreigner rather than support home industries. It seemed at times as if certain politicians took the attitude of saying to the foreigner: "Come and supply us with what we want. Our own people have been doing very well, but we want you to have a chance." The Government would not let them alone, and it would be a sad thing for this country if, in consequence of the interference with industry, thousands of people were thrown upon the dole.

MR. W. H. PATCHELL, president of the Institution of Mechanical Engineers, replied. They had been told, he remarked, that they should not advertise their losses, but should rather emphasise the orders which they had got. What they needed was confidence, both in themselves and between employer and employé; propaganda was needed to enlighten the workers who were at present misinformed. During the first quarter of this year trade disputes had led to the loss of 2,100,000 working days, as compared with 1,200,000 in the corresponding period of last year. Was not confidence required on both sides to ensure an alternative to such suicide? They heard of industrial unrest, and were threatened with a demand for £1 a week increase in wages in certain skilled trades. Could it be wondered at when sweepers were being paid higher rates than skilled mechanics? Happily figures and returns showed that trade was on the up-grade. Was it not possible to get together and, forgetting all about politics, find the best measures for restoring confidence between employer and employed, and show that British engineers could still do the best work and carry it out in the shortest time at the lowest cost? How else could they keep their best-trained men in this country? No fewer than 2,000 of them left for the United States of America last year. Mr. E. W. Petter's scheme would divulge figures which, although they should be on the table, could not be made known to the world. They should not allow such information to cross the water, no matter whether it was south, east, or west, because trouble was brewing for them in all directions. Surely they had people in power who knew what was wrong; if not, then it was time they did have them.

PROF. T. TURNER, M.Sc., A.R.S.M., president of the Institute of Metals, also responded to the toast.

MR. ANDREW SCOTT, secretary of Lloyd's Register, toasted "Our Guests," remarking that the Club was fortunate in having so many distinguished guests that evening. It was the youngest club in London, but had made very rapid progress during its short existence. That was due to its distinguished presidents.

MR. FRANK HODGES, M.P., Civil Lord of the Admiralty, in responding, said that science was the dynamic force of the world, and the politician should be no more than the handmaiden of science. There used to be an idea that the labour movement was antagonistic to science. He wished to say there and then that labour understood that they had reached the stage when they could not progress and could not indefinitely support a population of 47,500,000 unless they relied solidly and firmly on science. He believed that the limitations of scientific progress were not imposed by labour, but by the Stock Exchange, brokers, financiers, and shareholders who wanted a quick return upon capital.

SIR RICHARD REDMAYNE, K.C.B., M.Sc., also replied to the toast, as well as SIR HUGH DENISON, K.B.E., the latter remarking that the placing of the contract for the largest bridge in Australia in England was gratifying, as was also the fact that this country had obtained contracts to the value of £400,000 from the Commonwealth telephone service in competition with the world. During the three weeks he had been in England he had received several hundred letters from men who wished to go to Australia.

MR. GEO. ROBERTS agreed as to the need for confidence between the employer and employé; they must reconsider policies in order to preserve markets for the workers, and trade questions should be considered on their merits, irrespective of politics, and the best adopted for present needs. It could be proved that in no instance had £1 more been paid for an article because protection was given to the industry. Such questions should be lifted out of party politics and considered on their merits by joint representation of workers and employers; thus only could employment be ensured.

Responding to the toast of the "Engineers' Club," proposed by MR. E. W. PETTER, the chairman said that the Club hoped in the future not only to provide the ordinary club amenities, but to take a view of its work which would help forward the interests of engineers and engineering generally. The membership was 3,150, and no fewer than 450 meetings, lectures, dinners, and smoking concerts had been held in the rooms of the Club. An adequate technical reference library under their own roof would add to the value of the Club, and he appealed to members to send lists of suitable spare books so that a start could be made. The Club had offered hospitality to the members of all the engineering institutions of the Empire who were visiting the Wembley Exhibition, and they had received gratifying replies, together with reciprocal invitations.

During the reception and dinner the string band of H.M. Scots Guards rendered a programme of music.

Large Electrical Undertakings in North America.—There were 108 electric light and power companies in the United States and Canada having an output of more than one hundred million kWh during 1923. This compares with 94 in 1922, an increase of 15 per cent. Of this number 14 reported an output of more than a thousand million kWh during 1923. This compares very favourably with six such companies during 1922. Of these super-companies in 1923, 11 were operating in the United States and three in Canada. The total output of these 108 companies was 51,809,127,639 kWh. The average load of the 102 companies in the United States was 5,122,105 kW. The Niagara Falls Power Co. again led the country, reporting a total output of 2,595,847,000 kWh. The Commonwealth Edison Co. of Chicago was a very close second, with 2,573,286,711 kWh. The New York Edison Co. and the United Electric Light & Power Co. combined were third. The Hydro-Electric Power Commission of Ontario, however, reported the largest output of all the systems in the world with 2,906,519,819 kWh. The largest peak load was reported by the Commonwealth Edison Co. with 624,000 kW, followed by the Edison-United companies of New York with 536,533 kW over a thirty-minute period and an instantaneous peak load of 555,433 kW. The 102 companies operating in the United States generated 39,926,114,797 kWh. This figure is approximately 83 per cent. of the energy generated by all the central stations in the United States during 1923. The data are fully tabulated in the *Electrical World*, from which these particulars are taken.

A Tapping Switch for Power Transformers.

A New Brush Device.

THE two usual methods of effecting a change in the tappings of transformers, namely, by bringing them to oil level inside the transformer tank, or to terminals outside the tank, possess the disadvantage that the transformer must be switched out or disconnected from the supply before a change in tappings can be made. A further disadvantage of the first method is

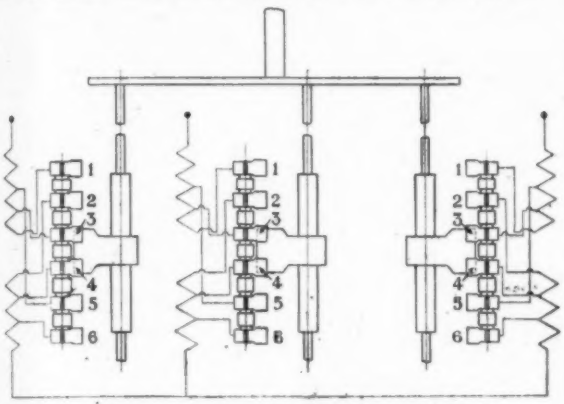


Fig. 1.—Diagram of Connections of Tapping Switch.

Switch blade connecting	H.P. volts	Switch blade connecting	H.P. volts
1 to 2	5%+	4 to 5	2½%−
2 „ 3	2½%+	5 „ 6	5%−
3 „ 4	Normal		

that the cover of the transformer tank must be raised to give access to the tappings. With the second method live high-pressure terminals which are outside the transformer are liable to accidental contact.

To overcome these disadvantages, the Brush Electrical Engineering Company, Ltd., has developed a high-pressure oil-immersed patented tapping switch, which can be operated with a minimum of trouble from outside the transformer tank. It can be supplied with single-phase or 3-phase power transformers of the indoor or outdoor type, and for electric furnace transformers—in fact, for practically any transformer up to a pressure of 33,000 volts.

Fig. 2 shows a 3-phase transformer fitted with a tapping switch, from which the construction and operation of the latter can be followed.

The switch is operated by means of the tommy bar A, inserted in the holes in the spindle B; the tommy bar also acts as a pin which forms part of a foolproof locking arrangement. This locking arrangement provides for locking the switch in any one tapping position, but not in an intermediate position. Possession of the key of the locking arrangement is essential for operating the switch.

The spindle B is connected by means of a nut and thread to the rods C, which carry the moving contacts D of the tapping switch; rotation of spindle B therefore raises or lowers the moving contacts. The spindle is fitted with an indicator, which registers on an indicator plate—fixed to the top of the transformer tank—the voltage of the tapping to which the switch contacts are connected.

It will be noticed that movement of the switch spindle B effects the same change in pressure on all phases simultaneously.

The contacts to which the tappings are connected (E), and the moving contacts D are so proportioned that no portion of the winding is short-circuited when operating the switch. The diagram, fig. 1, shows the ingenious method by which this result is attained, the windings of each phase being divided into two sections.

Before operating the switch the low-pressure side only need be switched out or disconnected from the load.

When fitted to weatherproof transformers, the operating spindle is provided with a weatherproof cap to prevent moisture creeping down the spindle into the transformer tank.

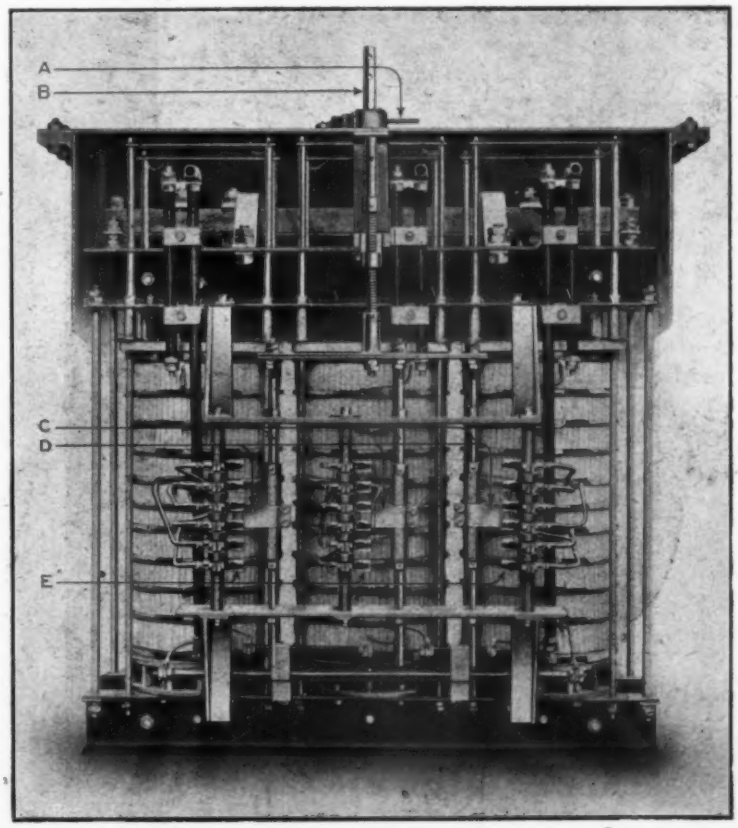


Fig. 2.—Brush Transformer with Tapping Switch.

The Junior Institution of Engineers.

Annual Dinner.

THE annual dinner of the Institution, marking its fortieth year of existence, was held at the Monico Restaurant, Piccadilly Circus, on May 6th. The president of the Institution, Sir J. Fortescue Flannery, D.L., M.Inst.C.E., occupied the chair, and Mr. W. A. Tookey acted as toastmaster.

After the dinner and the toast of "The King," Sir ARCHIBALD DENNY, Bart., proposed the toast of "The Institution." Sir Archibald recalled the fact that it was thirty years since he had occupied the position of president. Then the Institution, which originally had 20 members, possessed a membership roll of 373; to-day there were over 2,000 corporate members. The speaker dealt with the activities of the Institution in the form of a brief review, mentioning the self-governing sections at Birmingham, Manchester, Newcastle, Dartford, Plymouth, and Loughborough. The foreign branches were as far apart as Melbourne and Assam. The visits arranged for members were of particular value; he urged members never to miss these. One of his earliest inventions as a marine engineer was the result of a visit to a sewing-machine factory. Other important features were the library and the engineers' register, to which many firms now made regular resort. The opportunity afforded to young engineers to meet the leaders of the engineering profession was invaluable. Many illustrious men had deemed it an honour to act as presidents of the Institution—he mentioned Dr. Unwin, Dr. Silvanus Thompson, Sir William White, Sir Charles Parsons, and Commendatore Marconi. The Institution was prospering and would continue to progress.

MR. C. O. MOURANT, chairman of the Institution, in responding to the toast, acknowledged the indebtedness of the Institution to the eminent gentlemen who had acted as presidents and vice-presidents, as well as to the energetic past-chairman and the secretaries. The Institution did not hope or wish to compete with the senior institutions. It offered facilities which the latter were unable to afford their members. Above all it promoted a spirit of friendship, without which success was rendered void. The Institution, in common with other similar bodies, had felt the effects of the past few years, but at no time had the membership actually decreased. He anticipated that when the Institution celebrated its jubilee in ten years' time it would have a membership of between 3,000 and 3,500 members.

MR. W. J. TENNANT (vice-president) proposed the toast of "Marine Engineers." He referred to the important part played by this section of the profession during the war, when

it maintained the lines of communication with our fighting forces. He said that the Institution owed a great deal to marine engineers for its foundation. Among marine engineers none was more eminent than their president, Sir J. Fortescue Flannery.

Sir J. Fortescue Flannery responded to the toast, expressing satisfaction that he had been so appropriately called upon to do so. He stressed the necessity for engineers to specialise, to take up a subject and pursue it wholeheartedly—not, however, to the rigid exclusion of everything else. Marine engineering had, with other branches of engineering, considerably enlarged its scope during the past few years. But a short time ago the provision of engines in ships developing 7,000 h.p. was hailed as a remarkable feat, but now 30,000 h.p. over one keel was not uncommon. But past progress was nothing to what lay ahead; engineers needed to have great faith in the future of engineering, than which nothing had done so much in the advancement of civilisation. In conclusion he expressed his gratification at the honour bestowed upon him by his appointment as president of the Institution.

Mr. H. J. Edgar (vice-chairman) proposed the health of the guests, and Sir T. O. Callender, in responding, said that it was his regret that he had not known the Junior Institution of Engineers before; he had spent a most enjoyable evening. It was a great thing to have a body of young men fitting themselves to take the place of those who were going. The discussions, which were a feature of the Institution, were a valuable training in self-expression.

Mr. W. A. Tookey thanked the secretary for the excellence of the arrangements, and Mr. H. G. Riddle, in replying, acknowledged the assistance of Mr. H. V. Pointon.

Mr. R. L. Kirlew proposed the health of the chairman, which was accorded musical honours, and Sir J. Fortescue Flannery briefly replied, saying that the evening had been a most enjoyable one. Mr. A. W. Marshall recalled events in connection with the Institution when Sir Archibald Denny was the president. During the evening concert items were rendered by Miss Doris Waymark, Mr. Norman Long, and Mr. Charles True.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The M.V. Model Motor.

The Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, produces a model motor of excellent design suitable for driving toys, shop-window displays, and similar devices. The motor, which is illustrated in fig. 1, develops about 1-40th h.p. when running at a speed of 2,000/2,500 r.p.m. It measures only 6¼ in. in length, 6 in. in width, and 5¼ in. in height, and weighs approximately 7 lb. The field

Fig. 1.—The M.V. Model Motor.

is built up of high quality iron laminations, and the field coils are former wound. Cotton-covered wire is used, and after winding the coils are treated with insulating varnish, and the completed field is dipped in varnish and dried. The armature is wound with double-silk-covered wire, and the connections to the commutator are bound by tape to protect them from damage. The armature is dipped in insulating varnish and dried. It is then carefully balanced before assembly. The machine is finished in dull stove enamel. If required adjustable resistances for speed variation are supplied.

The "Orbit" Fan.

The "Orbit" fan designed by Messrs. Veritys, Ltd., Plume Works, Aston, Birmingham, has an entirely new movement. While most oscillating fans oscillate in a horizontal plane only, the "Orbit" has an elliptical traversing movement. As the blades revolve they travel from right to left and up and down in the line of an ellipse, thereby giving a much greater range than most other fans. It is made for either direct or alternating current, and is in every way suitable for use either at home or in tropical countries. The regulation in both a.c. and d.c. fans has three speed and "off" positions. The blades and guards are of the safety two-ring type, and have a brass finish to save cleaning and deterioration. The elliptical movement is obtained by means of two driving arms actuated by a double-reduction worm gear. Owing to the accuracy with which the gear is made, a perfectly smooth and noiseless movement is obtained. The worm gears are cut from cast steel, and the worm wheels are in cast phosphor bronze accurately machined. The elliptical movement is started by simply turning a knurled knob to the right or to the left.

It can be used as a fixed fan. The blades do not stop revolving when the elliptical movement is stopped. The fan has a "fool-proof" device to prevent damage to the fan or gear through any obstruction; should the guard or gear be held in any way the clutch slips.

A New "Universal" Cooker.

A very compact form of electric cooker has been introduced by Messrs. L. G. Hawkins & Co., Ltd., 116, Charing Cross Road, W.C.2. This is designed to perform all kinds of

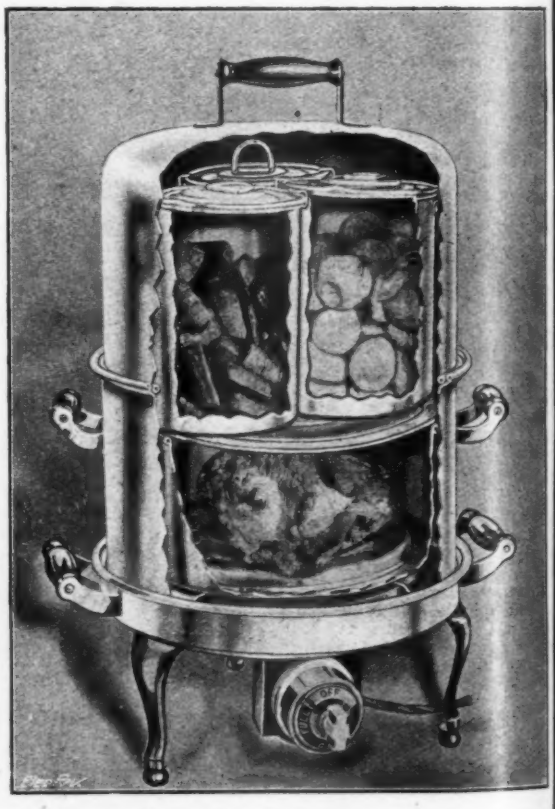


Fig. 2.—A New "Universal" Cooker.

culinary operations, and to this end is equipped with a whole host of utensils. A general view of the cooker in use is given in fig. 2. The main body of the cooker, which, together with all utensils, is of aluminium, consists of three parts: A tripod base 15 in. in diameter, in which is placed the element, consisting of an 8-in., 660-W hotplate; a container (9 quarts capacity); and a domed cover. A three-heat indicating switch is fitted, and convenient handles are provided on each part. The overall height of the cooker is 25 in. The utensils comprise a roasting pan, a grid for roasting and baking, a cover for the roasting pan, a boiling pan, a baking and broiling rack, a biscuit pan, a pie pan, a bread or pudding pan, an "angel cake" inset, six muffin pans, and a triple vegetable set. It will thus be realised that there is very little lacking in the equipment.

Electrocultural Research.

THE sixth interim report of the Electroculture Committee, appointed by the Minister of Agriculture and Fisheries in February, 1918, was issued recently. The report is not intended for publication, but we have permission to publish the following extracts:—

The work carried out by the committee between 1918 and 1923 was directed chiefly to ascertaining the type of electrical apparatus most suitable for the production of high-pressure discharge, the maximum effective strength of current, and the effect of the discharge applied under field experimental conditions to spring-sown cereals. As regards the last-named work, the Committee has shown that on the average an increase of 20 per cent. may be expected when certain spring-sown cereals are subjected to the discharge. The Committee has also erected an apparatus for use in actual farming practice, and ascertained its capital cost.

Further, the Committee has shown that with an electrical installation with overhead wires whose distance apart is not much in excess of their height, fully half the current supplied to the wires may be expected to reach the crop; it is also clear that there is a very considerable area surrounding the electroculture area, especially on its leeward side, which receives a discharge much in excess of that which passes normally between air and earth.

The results obtained in 1922 from pot culture experiments were so striking that the Committee decided to discontinue temporarily the field work and to concentrate on pot culture, small plot and laboratory work, for a time, with a view to ascertaining the most suitable periods and the most suitable hours of the day for the discharge.

The pot experiments were carried out at Rothamsted, and the small plot experiments at Rothamsted and Lincluden (Dumfries). The laboratory work was carried out at the Imperial College of Science and Technology.

An "economic installation," which covers an area of about 4¼ acres, was erected in 1922 to demonstrate the type of installation which would be suitable to actual agricultural practice. The supporting poles were of such a height as to allow of a clearance of 15 ft., to permit the passage of a harvest wagon. The field was put under swedes in 1923, to which the discharge was applied for one month only. No actual measurement of crop yield was made, since no suitable control area was available. Physical measurements were carried out on the economic installation, an account of which is given in an appendix.

A detailed report by Professor Blackman on the pot experiments is given in an appendix. Nine experiments in all were carried out at Rothamsted with barley, the plants being subjected to the electrical discharge for the first month (commencing May 14th) or the second month (commencing June 14th) or the third month (commencing July 14th) of the season or for the whole three months, and in each case for one hour and six hours daily; a further experiment dealt with the effect of protecting the plants from the normal air-earth current. The best results were given by electrification during the second month only, and in this case electrification for six hours daily was more effective than electrification for one hour daily. This result confirms that obtained in the pot culture experiments in 1922, when electrification for six hours daily during the second month also gave the highest yields.

Pot culture experiments to determine the effect of ordinary atmospheric electricity have been carried out for three years. In these experiments plants are placed within an "earthed" wire cage to protect them from the normal air-earth current. The results obtained so far give some indication of a beneficial effect on plant growth of atmospheric electricity.

In further experiments an effort will be made to obtain artificial conditions exactly comparable to the earth's field.

The small plot experiments at Rothamsted had to be given up, as the crop failed as the result of the selection of new ground and of the abnormal season. The small plot experiments at Lincluden were carried out on oats. Plots were electrified for the first, second and third months and for the whole season respectively.

In an appendix the yields from the electrified plots are compared both with those of the adjacent control plots and with the mean of the whole of the four control plots. On both bases of comparison electrification for one month only (whether first, second or third) gave better results than electrification for the whole three months, and of the individual months, electrification for the first month gave the highest yields. The differences between the three individual months were, however, very small when comparison was made on the basis of the mean of the control plots.

The results of the pot culture and small plot experiments confirmed the results of the pot culture experiments of 1922, *viz.*, that electrification for one month of spring-sown cereals is more effective than electrification for three months. A comparison between the individual months yields some evidence in favour of electrification for the second month of the growing season being most effective. With this second month's electrification the effect of the discharge both in 1922 and 1923 was a differential one, affecting grain weight rather than total weight of plants.

The laboratory experiments carried out at the Imperial College of Science have been designed to ascertain the after-effect of the current. The after-effect from one hour's discharge has been found to be greater than that from three hours' discharge; and the after-effect from half an hour's discharge has been found to continue for nine hours.

By a continuance of these laboratory studies it is hoped to throw more light on the after-effect of the current.

It is proposed again in 1924 to confine the programme of work to pot culture and small plot experiments on the same lines as the work of 1923. Additional investigations in 1924 will, however, deal with the effect of the discharge over smaller periods than one month and the effect of varying the strength of the current, since no knowledge is yet available of the minimum strength of the current that is effective.

In 1925 the Committee hopes to resume field work, in order to test on various soils and with different climatic conditions the results obtained from the pot culture and plot experiments in 1922, 1923 and 1924.

Parliamentary.

[By Our Special Parliamentary Reporter.]

London Traffic Bill.—Standing Committee "B" of the House of Commons again considered this Bill last week. On Clause 6, which gives power to the Commissioner of Police to prescribe routes and issue licences for omnibuses plying for hire in the Metropolitan Police Area, Lt.-Col. A. POWNALL moved an amendment to provide that the appropriate highway authorities should be consulted before any new omnibus route was opened up.

Mr. P. HARRIS opposed the amendment, stating that many people would try and prevent omnibuses coming down their streets and ultimately there would be brought about the same difficulty as when the local authorities opposed tramway extensions.

Mr. H. MORRISON, on behalf of the London Labour Party, opposed the amendment, saying that the way in which Borough Councils had used their absolutely tyrannical veto on tramway development was conclusive evidence that they were not fit to have such powers as regarded omnibuses. He intended at the earliest possible moment to make an attempt to get the local veto on tramway development removed.

Ultimately the amendment was rejected.

The Committee later adjourned.

Wireless Direction-finding Stations.—On May 5th, Mr. ALEXANDER, Parliamentary Secretary to the Board of Trade, informed Captain W. Benn that there were at present wireless direction-finding stations at Berwick, Flamborough, and The Lizard, and new stations were contemplated in South Wales and at Niton, Isle of Wight. He was aware that in certain countries no charge was made for bearings given by direction-finding stations, but in view of the cost of the service in this country it was not considered that the whole of the cost should be borne by the Exchequer.

Post Office Wireless Stations.—On May 5th, Mr. HARTSHORN, the Postmaster-General, informed Sir H. Brittain that the revenue and expenditure respectively of the Post Office wireless stations for 1923-24 were as follows:—Leafield and Banbury, £42,342 and £45,455; Cairo, £10,599 and £45,683; Northolt, £7,174 and £11,176; and Stonehaven, £6,449 and £15,418. Similar figures for Caister were not yet available, but it was estimated that the deficit on the working of that station for 1923-24 was, approximately, £1,700. The estimates of revenue covered both commercial and Government traffic.

West Indian Telegraphs.—On May 5th, the House of Commons, in Committee, considered the West Indian Islands (Telegraph) Bill. The Bill provides for the establishment and working of a system of submarine cables and wireless telegraph stations in the West Indian Islands and British Guiana.

Mr. ORMSBY-GORE, on Clause 3, which specifies how the expenses of the system shall be defrayed, complained that the island of Montserrat had been badly served in the past, and yet, under the Bill, it would have to contribute to the scheme without getting any advantage out of it. It would be a very inexpensive matter to provide a small wireless station on the island.

Sir H. BRITTAIN asked whether this cable system would be an absolutely British-run and British-owned and controlled concern. His information was that the two cable companies concerned were controlled by the same directors and had the same *personnel*, and that every one of the directors was also a director of the American Commercial Cable Company, and that 55 per cent. of the capital of the companies was held by the United States nationals, or by British interests acting as nominees of the Commercial Cable Company.

Mr. W. GRAHAM, Financial Secretary to the Treasury, said the Bill continued the allocation of the burden between this country and the various West Indian Colonies and Canada in more or less the form in which it was allocated under the agreement with the West India and Panama Telegraph Company. That agreement would expire on September 30th. Contracts had been placed for about £304,000 as against an earlier estimate of £347,000. The total contribution of all parties was about £26,000 per annum, of which this country's portion was £7,900. It was anticipated that very soon the receipts

would exceed the annual expenditure and the net amount payable by this country would be about £5,500. If Montserrat could have been brought into the scheme without delay that was a course which could have been generally recommended. It would, however, have meant an alteration of the manner in which the shares were allocated among the different parties, and the delay in making the necessary arrangements would have been dangerous. They all desired to avoid seeing any island in this group outside communication. The authorities in Montserrat had taken steps towards the establishment of a wireless station which would be in communication with Barbados. There was every reason to believe that under the present scheme the island would be brought into communication with the other islands of the group. Any other proposition that might be put forward in the interests of the island would be carefully considered.

The Committee stage was concluded, and the Bill was reported, without amendment, to the House.

The Bill was read a third time on May 8th. Mr. J. H. THOMAS, the Colonial Secretary, said that arrangements were being made for the transfer of sufficient shares to place the control in the hands of British subjects, but the fact remained that the staff were nominally the servants of the American company.

Pacific Cable Board Bill.—On May 5th this Bill was read a second time.

Empire Wireless.—On May 6th, Sir H. BRITTAIN asked the Postmaster-General whether the Government intended to publish the correspondence which had passed between the Imperial Government and the Dominion Governments in connection with Empire wireless before and since the publication of the Report of the Committee on Imperial Wireless Telegraphy, also the correspondence and proposals received from the Marconi Company and the memorandum prepared by the chairman of the Committee on these communications and proposals.

Mr. HARTSHORN said it was not proposed at present to publish the correspondence referred to. Publication of the correspondence with the Dominions, in any event, could only be made with the assent of the various Governments concerned.

On May 8th, in reply to Mr. BAKER, who asked whether the Government had come to a decision with regard to the public ownership and control of the Imperial Wireless Chain, Mr. HARTSHORN said that the Government hoped to make an announcement on the subject at an early date.

Special Orders.—On May 7th, on the motion of Mr. GOSLING, Special Orders were approved in respect of Andover, Maesteg (Glamorgan), and Cockington (Devon).

Leafield Wireless Service.—On May 8th, Mr. HARTSHORN informed Mr. STURROCK that, prior to May 1st, the Leafield wireless station was reserved for a short period daily for the transmission of urgent Press telegrams to India on behalf of certain newspapers and news agencies. This service, which occupied a time totally incommensurate with its value to the Post Office or the senders, had lately fallen into disuse and had accordingly been suspended.

Published Specifications.

Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STEPHENS, Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

28,058. "Railway station train-indicator mechanism and the like." P. H. Waller. October 16th, 1922. (Addition to 168,122.) (214,067.)

28,336. "Electrolytic anti-corrosion systems." A. S. Gush and M. C. Gush. October 18th, 1922. (214,282.)

28,451. "Arrangement of apparatus for the electrical transmission of power." K. R. D. Shaw. October 19th, 1922. (214,283.)

31,551. "Electric generators or motors." J. H. Jones, J. L. Turner, and Dr. T. R. O'Keefe. November 18th, 1922. (214,288.)

33,650. "Electric lamp bulbs." J. J. E. Sloan. December 9th, 1922. (Cognate application, 2,704/23.) (214,290.)

34,186. "Registering (counting and/or measuring) telephonic conversations." E. Freund and S. Brociner. December 15th, 1921. (190,490.)

1923.

371. "Electromagnetic underground prospecting." Soc. Industrielle des Procédés W. A. Loth. January 4th, 1922. (191,389.)

1,484. "Electric insulators." T. L. Rees and W. D. G. Rees. January 17th, 1923. (214,323.)

1,557. "Thermostatic switch adaptors for electric circuits." E. A. Pye and Pryco, Ltd. January 17th, 1923. (214,325.)

1,688. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., and C. Gillings. January 18th, 1923. (214,331.)

1,765. "Electrical resistances." Akt. Ges. Kummler & Matter. January 30th, 1922. (192,382.)

1,901. "Electrical transmitter microphones." E. D. Young. January 22nd, 1923. (214,336.)

1,930. "Transformers for use in high-frequency circuits." A. H. S. Maccullum. January 22nd, 1923. (214,338.)

1,975. "Apparatus for the electrolytic deposition of metals." A. H. W Cleave. January 22nd, 1923. (214,340.)

1,986. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. May 25th, 1922. (198,329.)

2,162. "Means for limiting the pressure due to an explosion inside flame-proof cases in electrical switchgear and apparatus and the like." W. De Renzi. January 24th, 1923. (214,346.)

2,582. "Sparking plugs for internal-combustion engines." T. K. Turpin. January 29th, 1923. (214,352.)

2,836. "System and apparatus for telegraphically transmitting and reproducing writing, drawings, plans, and the like." P. M. Macintyre. January 31st, 1923. (214,355.)

3,230. "Electric condensers." J. H. Hewitt and Wilkins & Wright, Ltd. February 3rd, 1923. (214,363.)

3,944. "Electro-mechanical telephone systems and switching apparatus therefor." H. Baron (F. Aldendorff). February 9th, 1923. (Addition to 203,724.) (214,373.)

4,071. "Electric batteries." Efandem Co., Ltd., and J. Eaton. February 12th, 1923. (214,377.)

4,540. "Electric radiant fires." J. A. Getty. February 16th, 1923. (214,383.)

4,668. "Railway and tramway rail joints." J. M. G. Wylie, W. F. Smith, and J. E. Younger. February 17th, 1923. (214,384.)

5,897. "Swivelling couplings for electric cables." T. C. Winfield and R. J. Hall. March 1st, 1923. (214,389.)

6,349. "Installations for operating reciprocating electric motors." H. Japolsky and M. Kostenko. March 5th, 1923. (214,393.)

6,857. "Vehicle head lamps to prevent dazzle." G. V. Kent. March 9th, 1923. (214,399.)

7,516. "Anti-dazzle lamp for motor and like vehicles." R. I. Atherton. March 15th, 1923. (214,406.)

7,691. "Crystal detectors or rectifiers for use in wireless telephony and telegraphy." Burton, Delingpole & Co., Ltd., and J. T. Tilley. March 17th, 1923. (214,409.)

8,872. "Dynamo-electric machines." British Thomson-Houston Co., Ltd., and F. P. Whitaker. March 28th, 1923. (Patent of addition not granted.) (214,430.)

10,072. "Electrically-actuated piston gas valves." R. Maclaren. April 13th, 1923. (214,451.)

10,315. "Electric discharge tubes." General Electric Co., Ltd., and C. G. Eden. April 16th, 1923. (214,455.)

11,981. "Electrical process for obtaining metals having a high melting point, such as tungsten." Soc. Anon. des Brevets Berthet. October 3rd, 1922. (205,046.)

14,582. "Devices for advertising and like signs." A. H. Brackensey and Franco-British Electrical Co., Ltd. June 2nd, 1923. (214,488.)

15,090. "Light shade for electric bulbs and the like." E. A. Considine and G. Elston. June 9th, 1923. (214,492.)

19,674. "Terminals for electric cables." E. Martin. September 13th, 1923. (214,535.)

20,032. "Telephone systems." Western Electric Co., Ltd. (L. Poleskowsky). August 4th, 1923. (214,529.)

20,700. "Electric furnaces particularly for the melting and the treatment of composite metals and alloys." L. Lombardi. August 14th, 1923. (214,538.)

20,859. "Motor mechanism in electricity meter." Landis & Gyr Akt. Ges. August 18th, 1922. (202,644.)

20,862. "Supports for the conductors of electric railways." Soc. des Grands Reseaux Electriques. September 5th, 1922. (203,665.)

21,724. "Rotors for squirrel-cage alternating-current electric motors." Waygood-Otis, Ltd. (Otis Elevator Co.). August 28th, 1923. (214,536.)

21,727. "Loud-speaking public address systems." Western Electric Co., Ltd. September 8th, 1922. (203,677.)

22,707. "Electric incandescent lamps." General Electric Co., Ltd., and G. Higgins. September 10th, 1923. (214,540.

24,051. "Switch mechanism for electric light advertisements." H. Hirsch. September 7th, 1922. (204,713.)

28,337. "Ignition plugs." R. Bosch Akt. Ges. November 11th, 1922. (206,852.)

28,338. "Ignition plugs." R. Bosch Akt. Ges. November 13th, 1922. (206,857.)

30,628. "Electrical contact devices." C. O. Alexander, C. B. Johnson, and T. W. Simpson. December 5th, 1923. (214,563.)

31,244. "Self-winding electric clocks." Embe-Fahrzeug-Ubren Ges. December 14th, 1922. (208,539.)

32,182. "Electro-automatic targets." Cibles Automatiques Michoud Soc. Anon. January 18th, 1923. (210,058.)

1924.

4,305. "Method of laying armoured single-core cables." Felten & Guilleaume Carlswerk Akt. Ges. February 22nd, 1923. (211,869.)

4,836. "Registering (counting and/or measuring) telephonic conversations." E. Freund and S. Brociner. December 19th, 1921. (Addition to 190,490.) (Divided application on 190,490.) (212,249.)

New Motor-Generators for Electric Locomotives.—It is reported that tests of new motor-generators for electric locomotives to be placed in service on the Detroit, Toledo, and Ironton Railway have proved successful. The experiment, it is expected, will result in a saving in long-distance transmission of electricity for railroad operation, and in a saving in copper owing to the use of small diameter wire. The tests demonstrated the practicability of using high-pressure alternating trolley current at 23,000 volts to operate locomotives equipped with 600-volt direct-current driving motors. The new Detroit, Toledo and Ironton locomotives will be the first engines of their type to be equipped with self-contained apparatus for rectifying alternating current.—*Reuter's Trade Service* (New York).

Fire.—An unusual accident occurred in the operating theatre of the Cheltenham General Hospital on May 5th, by which the house surgeon (Dr. Power) and a patient received severe burns. Four doctors, including specialists, were present for an operation, and the anæsthetic had been successfully administered, when a spark from some electrical apparatus came into contact with a bottle of ether, which exploded with great force. The ether burst into flame, igniting Dr. Power's trousers and inflicting severe burns on his lower limbs and hands. The patient was severely burned about the head, but the other doctors escaped injury, though the nursing sister had her hair badly singed. The surgery was set on fire, but the flames were subdued by an extinguisher.—*The Times*.